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STATISTICS IN THE SERVICE OF ECONOMICS[1]

By Irving Fisher, *Yale University*

It has long seemed to me that students of the social sciences, especially sociology and economics, have spent too much time in discussing what they call methodology. I have usually felt that the man who essays to tell the rest of us how to solve knotty problems would be more convincing if first he proved out his alleged method by solving a few himself. Apparently those would-be authorities who are forever telling others how to get results do not get any important results themselves.

I well remember, nearly forty years ago, hearing a newly fledged professor of sociology deliver a learned lecture on methodology in sociology full of big words if not of big ideas. But he never, as long as he lived, contributed anything more than advising others how to do it. So far as I know, no one was ever materially helped by his advice.

And now here I am myself adding my own quota to the literature, already so big and so largely useless, on this perennially fascinating, if somewhat unprofitable, subject of method. In excuse I may say that this is only my second offense, the first being twenty-six years ago, and that I have hitherto, for the most part, tried to mind my own business and to saw my own wood instead of instructing others how to saw theirs. But I think my real reason for now and here breaking out on methodology is simply that it seems a suitable subject for me to choose in representing tonight both the Statistical Association and the Econometric Society, the oldest and the youngest of the scientific bodies devoted to the study of economic and social problems.

May I begin by saying that I am chiefly interested in both those societies as an economist, and I shall, accordingly, confine myself to the subject of statistics in the service of economics and only to one part of that vast subject, namely economic theory.

[1] Presidential Address delivered at the Ninety-fourth Annual Meeting of the American Statistical Association, Cincinnati, Ohio, December 29, 1932.

When, forty-two years ago, I wrote my doctor's thesis on certain mathematical investigations in the theory of value and prices, I was a student of mathematical physics and, with youthful enthusiasm, dreamed dreams of seeing economics, or one branch of it, grow into a true science by the same methods which had long since built up physics into a true and majestic science.

Of course, I was not the first to have such dreams for economics as a science. Cournot, Jevons, Walras, Pareto, Marshall, Edgeworth, Wicksell, and several others had dreamed those dreams before me. But some of these had too often found that the market for their wares was small and discouraging. The book which first fired my youthful enthusiasm was that of Auspitz and Lieben, Austrian bankers who, like another banker before them, Ricardo, wrote a highly theoretical treatise. But I found, when I visited Lieben in Vienna in 1893 that the readers of their *Investigations on the Theory of Value and Prices* had been very few. I know of no American economist except myself who has even read this notable book.

A year later, in 1894, I heard Edgeworth read a paper in the field of mathematical economics before the British Association for the Advancement of Science, and heard the, to me, unjustified criticism of it by Sidgwick, representing the typical economist of that time. It was with distress that I heard Edgeworth say he felt "damped" by hearing Sidgwick deplore the introduction into economics of such heretical methods as mathematics.

Even Cournot in those days was almost unknown among economists and had only barely been rescued from oblivion by Jevons and Marshall. Like the now famous Mendel in biology, Cournot in economics is an example of a scientist little appreciated until after he had died, and his work had, for a time, been forgotten.

A little later I again found that a contemporary of Cournot's, John Rae, had produced what I regarded then, and regard now, as a work of genius, deserving to rank, as to scientific method and results, far ahead of the *Wealth of Nations*, of which it was, in part, a criticism. Rae's work was not mathematical. It is easy reading and fascinating to those who read it. With Professor W. G. Mixter, who "discovered" Rae's neglected work and recognized him as a "fore-runner of Böhm-Bawerk," I did my best to help resurrect Rae's book, originally called *New Principles of Political Economy*. Later this was reprinted, rearranged and annotated by Professor Mixter under the title, *Sociological Theory of Capital*. I also dedicated my own books on Interest to Rae. But even now Rae's great book has not fully come to life. Rae not only exemplified what seems to me a correct *method* but he correctly

described a scientific methodology and contrasted his method with the unscientific method of Adam Smith.

Since there are no mathematical symbols in Rae's book, its failure to receive the prompt and full recognition it deserved must be due to something else than mathematics. It may have been in part his very methodology, which I so much admire but which at that time had no audience ready to appreciate it.

The difficulties encountered in getting most professed economists to adopt the methods of physical science made me nearly despair of ever living to see economics become a science in the sense that physics is a science.

A young economist in a western university, who sees eye to eye with me as to methodology, shocked and pained me about twenty years ago when he told me that his own enthusiasm had been so damped that he had practically given up his original life ambition of getting recognition for his contributions toward making economics into a true and useful science. But he was too easily discouraged. For even at that time, those of us who had still earlier entered economics from the approach of the natural sciences, as contrasted with the approach from philosophy or history, had already noticed a great change.

And today we suddenly wake up to realize that the methods which have made physics a science have at last taken a vigorous hold on the rising generation of economists. To illustrate, I need only mention, among many others, Frisch, Divisia, Rueff, Schumpeter, Keynes, Bowley, Amoroso, Gini, Haberler, Leontief, Zawadski, Kondratieff, Hotelling, Moore, Schultz, Roos, Evans, Crum, Ezekiel, Rogers.

Moreover, the establishment of the international Econometric Society two years ago, the meetings it has since held in Europe and America, and its journal *Econometrica* beginning next month, signalize this new birth of the scientific spirit in economics.

But what is the essence of the scientific method which these young economists have at heart? I shall try to interpret it. And I would also refer you to the interpretation of Schumpeter in a brilliant article to appear in the first number of *Econometrica*.

As I understand it, this new outburst of the scientific spirit is not a new "school" but simply an adaptation to economics of methods already nobly tested in the natural sciences. I hope it may mark the beginning of the end of "schools" in the sense of partisan groups or cults. The modern economist occupies a position midway between what used to be called the Austrian school and the Historical school. The Austrian school contributed, or shared with Von Thünen and Gossen in Germany, Jevons in England, Walras in Switzerland, and J. B.

Clark in America, the honor of contributing the fundamental idea of "grenz nutzen," or "marginal utility" as it has usually been called in English, or "final degree of utility" as it was called by Jevons, an idea corresponding closely to differential quotients as used in mathematics and mathematical physics.

Nevertheless, the first enthusiasm over the Austrian school's concept of marginal utility and its application was followed by disappointment. The Austrian school seemed to yield no second crop comparable with the first. One would-be facetious critic wrote an article on "The final futility of final utility."

Professor (afterward President) Hadley voiced this disappointment when he said:

> We are teaching more about the theory of utility than did our fathers, but are we doing so much for the realization of that theory in the organized life of the nation? If we fail in our influence upon public life, we fail in what is the most important application of our studies, and in what may almost be said to constitute their fundamental reason for existence. . . .
>
> The older political economy expressed its results in pounds, shillings and pence. They might be true or they might be false, but they were at any rate in a form where they were capable of measurement and verification. . . .
>
> The new political economy has substituted a more vague conception of wealth for the more concrete one, and many of its propositions have suffered a corresponding loss of clearness and precision. The mercantile school of economists had measured wealth in terms of money. The first generation of their critics measured it in terms of food; the second and third generations measured it as "commodities"; our own generation measures it in terms of utility. But food is a less definite and tangible measure than money; commodities are a less definite and tangible measure than food; and utility is perhaps the least definite and tangible measure of all. . . .
>
> I am disposed to think seriously that the excessive use of psychological terms and conceptions, to the neglect of purely commercial ones, has been the most potent cause to weaken the influence of economists among statesmen and men of the world.

President Hadley was right. The Austrian School, though marginal utility was a real contribution, obviously lacked a full contact with reality.

And yet the German Historical School, though it stressed realities, was even more disappointing. Starting off with a commendable reverence for facts, just as does the physicist, they mistook their compilations for "induction" in economics. They got nowhere. Their ponderous volumes contained vast collections of historical facts and statistics but there was little or no connecting framework of principle.

Both the Austrian deductive school and the German historical school have now ceased to command much enthusiasm; for some time the

effort has been to find a satisfactory way to join together theoretical and historical studies. This effort has found expression through mathematics and statistics and mathematical statistics—the mathematics to express theory and the statistics to express historical facts.

The Econometric Society, as stated in its constitution, stands for the "advancement of economic theory in its relation to statistics and mathematics." No one today needs to apologize for, or even defend, either statistics or mathematics as legitimate and helpful instruments in the service of economics. Both are found abundantly in any modern economic journal. The Statistical Association now has an entire journal devoted to mathematical statistics. Any modern text book of advanced economics will usually contain tables and charts of statistics, diagrams of supply and demand and some mathematical formulae, if only in the appendices.

This has all come about so gradually that any one who will take the trouble to compare modern economic literature with that of one and two generations ago, even by turning a few of the pages at random, and looking for diagrams and formulae, will be startled at the contrasts. Ricardo in his *Principles* made no use of mathematical symbols or of statistics. Even when I was a student, the leading economic work of the time, the *Advanced Course*, as Francis Walker's text book was called, contained no statistics or mathematics. In my doctor's thesis in 1891, I devoted several pages to defending the use of mathematics in economics against the objections then alleged against it.

Yet mathematical method merely consists in the use of symbols as short hand expressions of measurable magnitudes, and statistical method merely "consists in the study of social phenomena which can be counted." Thus they are conveniences rather than necessities.

That is, while statistics and mathematics are, or can be made, helpful in joining theory and fact into a true economic science, they are incidents rather than indispensable instruments for that purpose.

Scientific economics will naturally make liberal use of mathematics and statistics. But the essential of scientific method is not a matter of form but of substance. The first essential, in my opinion, is to recognize the absolute distinction between scientific and historical truth, that is between principles and phenomena. My impression is that few, if any, economic students ever grasp this fundamental distinction who have not had some considerable training in the physical sciences. A scientific truth is in the conditional form: "*if A is true, then B is true*"; while an historical fact is in the unconditional form: "*A is true*" or "*B is true*." If this distinction were clearly grasped by every student who wishes to understand and discover sound economic principles, economics

would, I believe, develop into a true science very speedily. Until the great majority of our students do grasp this distinction, much of economic writing will be pseudo-science either of the type of half-baked economic theory or of half-baked economic history.

As I said in 1906, when chairman of the economic section of the American Association for the Advancement of Science:

> Those who maintain that economics is not and never can be a science usually base their contention on the fact that social phenomena are not constant, like, they say, the phenomena of astronomy or physics, but differ widely at different times and under different circumstances. They point out that the determination of prices under modern free competition is quite different from their determination under the mediaeval system of custom and status; that the remuneration of labor depends on what are the historical and legal institutions with respect to slavery, labor legislation, etc.; that the economic phenomena of today are not comparable with those of the times of the Greeks and Romans, nor are the phenomena in America comparable with those in Russia.
>
> To one who is familiar with the spirit of science, however, these considerations, so far from being objections, are really confirmations of the theory that economics ranks as a science. For in all science it is fundamentally true that phenomena will "differ according to circumstances," and the office of the scientist is simply and solely to find out under what circumstances one set of phenomena will occur, and under what circumstances another set will occur. We could hardly claim that hydro-statics is not a science for the reason that, in a mountain lake, water is found to be stationary and at a level, whereas at Niagara it is found to be in motion and passing from one level to another; that, whereas the water in a mill-race passes in a downward direction, the water which we draw in our houses moves through the pipes upward; that whereas, by means of a syphon, water may be induced to flow out of a receptacle, it will, in an ordinary tub, remain there. The whole science of hydro-statics has developed as a consequence of the persistent effort to unravel these puzzles, and today we know not only that under different circumstances water will act in different ways, but we can formulate what are the precise conditions under which it will act in each separate manner.
>
> In economic study we should in like manner apply ourselves to discover what conditions make the difference in the phenomena between modern and ancient or eastern and western civilizations, rather than content ourselves with the truism that they do differ. Much of the field has in fact already been covered. It is known, for instance, that under conditions of free contract and competition, the price of an article will be determined by the intersection of its supply and demand curves, and that, on the other hand, if the régime be one of monopoly, the price will be determined on the principle of "what the traffic will bear," in the manner so admirably shown by Cournot. In these cases the results are not absolute and unconditional, but depend on specified hypotheses. In this respect they are exactly similar to any other scientific result.
>
> If economics is a science, its truths must be conditional. Thus, the incidence of a tax on ground rent will lower the value of land, provided there are no counteracting causes. This does not assert that actually, after such a tax, the value of the land will fall; for in the meantime some opposing cause may have intervened, such as the discovery of an oil-well. Again, an increase of the quantity of circulating medium will raise prices proportionately, provided the velocity of

circulation and the volume of business transactions remain the same. This "quantity theory" does not assert that prices do rise after every increase in the quantity of money, and those who thus interpret it are guilty of the confusion already noted between conditional and unconditional truth in other words, between a scientific law and an historical fact.

True science does not consist in the mere grouping of historical phenomena. In fact, Bacon makes a distinction between what he calls the popular and the inductive method, or what may be preferably called, following the example of John Rae, the systematic and the scientific. The two are commonly confused, but are entirely distinct. "System" consists in classifying phenomena; "science" consists in discovering the laws to which they conform. System explains phenomena by means of what is common and familiar; science explains them by what is simple, however recondite. System is exemplified in such descriptive studies as grammar, descriptive geography and history; science is exemplified by such analytical studies as mathematics, physics, and latterly, biology. The classifier or system-maker is content with generalization of facts. These express the usual order of events: for instance, that the sun rises once a day. They do not express the reason or principle.

Many studies which are now scientific had their origin in what was originally systematic. The predecessors of the modern physicists classified bodies into "light" and "heavy." Iron, they maintained, is heavy and therefore falls; fire is not heavy, and therefore rises How different is this obsolete method of treating the subject from our modern analytic notion of gravity, or rate of increase of velocity, by means of which are explained both the falling of iron and the rising of "fire"!

Similarly, the prototype of biology was "natural history," and consisted chiefly in the mere classification of animals and plants into species, genera, etc. Modern biology has supplanted such elaborate classification by introducing, through Darwin, the analytical ideas of heredity, variation and selection, and in this way the descriptive study of natural history has been converted into the true science of biology.

And Mendel's laws have added insight to Darwin's and given us absolute mathematical conclusions in terms of probabilities and, in some cases, of certainties. We know if two blue eyed persons marry all their children will have blue eyes. If A is true, then B is true.

The same evolution which has been outlined in physical and biological science is doubtless taking place in economic science. Yet it must be confessed that few have yet mastered the distinction between a general fact and a scientific law. When we hear it stated as fundamental in political economy that skilled labor is better paid than unskilled, it is clear that this is merely a general rule and not a necessary law. The single fact that certain seamstresses, though skilled, are ill-paid, is sufficient to disprove the statement as a necessary law, though it does not affect it as a general fact.

The historical school justly complains of the superficial character of the theories which have been sometimes offered. This objection holds, however, not against theory as such, but against false theories; and herein lies the virtue of Bacon's method. The inductive method, by which any theory of phenomena must be checked by reference to actual historical fact, thus forms the means of distinguishing between truth and falsity. Rejecting false theories is quite different from

rejecting all theories. What is needed now is [illegible] to rid ourselves of the false and superficial theories, on the one hand, which have been constructed, *a priori* and irrespective of facts, and on the other hand, to release ourselves from the cheap empiricism of the [illegible], who understand their task as merely one of generalizing phenomena without analyzing them.

Science is one. The logic of economic science, as of all other science, is one — a combination of induction and deduction. Facts are at once the test and the material of science; but laws are its ultimate goal. Laws are not facts, but the relations between facts. Newton's first law of motion, that a body, left to itself, moves uniformly in a straight line, is not a fact, nor is it a general expression of facts. Probably no particle in the universe has ever moved exactly in a straight line or with uniform velocity for so much as a single second. Yet it would be an error to conclude that Newton's law is unreal and untrue to actual nature. The law has an "if" in it: "If a body were acted on by no forces, or by perfectly balanced forces, its motion would be uniform in both rate and direction." Withdrawn thus from actual events, Newton's law seems to the non-scientific mind to lose all objective truth. This again is an error. Newton's law is absolutely true to nature. The fact that it is conditional does not make it arbitrary. We are not free to replace it by the mediaeval opinion, viz., "If a body is let alone it will *gradually spend its force and slacken its speed*." This formulation, unlike Newton's law, would not stand the test of facts. A valid law is true at all times and places, in the sense that, should the particular conditions arise, the generalized result would follow, but not in the sense that the particular conditions must needs ever arise.

It is sometimes said that the ability to predict is the final test of science. But it is not a test of science only. Successful prediction requires two conditions: one is a knowledge of science — of what will happen under given circumstances, and the other, equally essential, is a knowledge of history — of the particular circumstances of the present moment, out of which the future, to be predicted, will grow. Failures of prediction are due to the lack of either of these two essential conditions.

An example of a failure of prediction due to imperfect knowledge of facts is found in the case of the closure of the Indian mints to silver in 1893. It was expected that the value of the silver rupee would be maintained at 16 pence. But no account was taken of the large hoards of silver among the natives. After these had been put into circulation the price of the rupee did eventually rise to 16 pence and has remained there. In this case the failure of prediction at first was due, not to any defect in monetary science, but to ignorance of Indian history.

Usually, however, failures in economic prediction are due to the lack of scientific rather than of historical knowledge. In the Civil War, when there was a premium on gold, the scientific explanation of which was really simple, the public attributed the premium to the machinations of speculators. Accordingly, Congress was induced to close the Gold Exchange, whereupon, to the consternation of the framers of this foolish prohibition, the premium on gold soared higher than ever. The result was a hasty and shamefaced repeal.

Experience of this kind is too common in economic legislation. It serves as a warning that we should know something of economic science before attempting to tamper with economic conditions. The men who need this warning most of all are those who despise all "theories" and call themselves "practical." It is they

who legislate a measure one day and have to repeal it the next. A truly practical man can predict how a measure will work, and his power so to do requires not only what is called "practical" but also what is called "theoretical" knowledge; a knowledge, in short, not only of history but of science.

Unfortunately as yet neither economic laws nor economic data are sufficiently known to enable economists to make safe predictions. In both respects it is still a backward science as compared with many others. A few months ago astronomers from California and Japan came to New England to observe a total eclipse of the sun. The eclipse came off on schedule time within a second or two—so nearly perfect is this superbly scientific science of astronomy. This was because these astronomers had both sorts of knowledge. They knew on the one hand that, under certain conditions, the moon would pass between the earth and the sun (that if A was true, then B would be true) and they knew, on the other hand, that those conditions, A, were fulfilled. Consequently they knew in advance what soon became a historical fact, that (unless something had been left out of their calculations) the eclipse must occur, and that B would be true.

Contrast this with our economic predictions. We are now going through an economic eclipse which began in September, 1929. But few if any economists predicted it, or, if so, they failed to make their predictions public. Economics will be more of a science when we can predict depressions.

Yet we have the comfort of knowing that there are physical sciences like meteorology which are not yet able to make very good predictions. While the astronomers could tell with precision and a century ahead of time when the moon would obscure the sun the meteorologist could not tell, even approximately and even a day ahead of time, whether or not some cloud would obscure both. So it turned out that while the Japanese coming to Maine saw the moon eclipse the sun, the Californians a few miles away only saw an unpredicted cloud eclipse the eclipse.

It was because practically all the would-be economic forecasters have for the last four years failed dismally to tell the business man what to expect that a business man, Mr. Alfred Cowles, III, has stepped forward to finance the Econometric Society in the hope that out of it might grow scientific prediction. He has also organized a statistical laboratory where he is trying to make use of the most promising methods. He has a paper to present here at a joint session of the Statistical Association and the Econometric Society on some of the failures of recent economic predictions.

It is well that we face these failures and that, when we fail, we confess

it with due humility. I confess it. It is true that in September, 1929, I publicly stated my belief that we were "then at the top of the stock market" and that there would be a recession, this forecast being largely on the strength of the elaborate correlation work of Karl Karsten. And this proved true. But unfortunately I also stated my belief that the recession would be slight and short; and this proved untrue. I can now see that my failure was due to insufficient knowledge of both kinds, scientific and historical. I did not then know certain scientific laws of depressions and I did not know, as well as I should, the historical background of conditions. For instance, I had counted on the continuance of the open market policy of Benjamin Strong of the Federal Reserve Bank of New York, not knowing that these had largely died with Governor Strong the year before. As to the laws governing depressions, I did not then know, what since I have learned and embodied in my book, *Booms and Depressions*, the important rôle of over-indebtedness and its tendency to break down the price level through distress selling, contraction of deposit currency, and slackening of its velocity. Had I had these two sorts of knowledge in 1929, even to the modest extent which I can now claim to have them, that is, if I had had more correct and complete historical information on the one hand, and more correct and complete knowledge of some of the scientific laws involved on the other, my failure to predict this economic eclipse would at least have been lessened. But even if we had had all the foresight which "hindsight" and scientific studies have since brought, we could still only have made a general and largely qualitative rather than a specific and really quantitative prediction. Moreover there are always unforeseen circumstances. Any prediction, even in astronomy, must always be subject to the reservation that "other things remain equal" or nearly so.

We economists can, I assume, never hope to rival astronomical predictions of eclipses. We shall be lucky if we can ever rival meteorological predictions of cloudiness. Yet there is no reason to despair of forecasting depressions—and quantitatively to some extent. The sessions of the Statistical Association this year are very largely devoted to studies of this depression problem. They should help lay a basis for further and progressively successful studies of the nature of depressions, which studies should ultimately bear fruit in successful forecasting. But such an outcome will not eventuate from such merely *a priori* studies as characterized the Austrian school, nor from such merely descriptive studies as characterized the historical school, nor even from the grinding out of correlation coefficients between statistical series whose inner relationships are unknown or possibly non-existent. Pure

empiricism will be as disappointing as all the other methodologies which we are quietly relegating to the scrap heap. We need a rational element along with the empirical.

Astronomers could never have predicted eclipses by means of correlation coefficients. Correlation coefficients are seldom used in astronomy although the statistical material available for such calculations is vastly greater than in economic science. The reason is that usually better and more fundamental relationships are available than the mere linear relationships obtainable by the correlation method. Such relationships are necessarily superficial, whether in astronomy or economics, and must ultimately give place to something less superficial. No astronomer would think of taking the raw statistical data which his telescope discloses, consisting of innumerable angular measurements, and simply throwing them into the hopper of a correlation machine. If he did, the hodge podge which would come out he would never dream of calling science. And I fear much of the economists' and statisticians' calculations with correlation coefficients will not get us very far. They may be a good stop-gap or make-shift while we are deciphering the true rational relationships.

The distinction between shallow statistical empiricism and a rational statistical analysis is well illustrated by contrasting the earlier treatment of workmen's budgets and the recent use of the same data by Ragnar Frisch, now editor of *Econometrica*.

The budget data of workmen used to be put merely in the form of percentages spent on food, clothing, rent, fuel, lighting, etc. The most interesting result was the so-called "Engel's law" that the bigger the income, the smaller percentage of it spent on food. The fact that economists had the temerity to call this empirical generalization a "law" is itself a reflection on economics as a science. A few of us have tried, on the other hand, to use these percentages together with data on the cost of living as a means of calculating statistically the demand curves and marginal utility curves which, according to economic theory, must underlie and determine the workman's choices of food, clothing and so on, resulting in the budgetary and price phenomena. Of two available methods of tracing our way back from the budgetary phenomena to the fundamental law of demand, that of Ragnar Frisch is the most practical. His actual statistical results are as yet preliminary and may well be found inaccurate. But as to method, his work is a model of what statistics should be in the service of economic science. Thus may we give a place, in statistics, even for such fundamental, though highly theoretical concepts as that of marginal utility. The shadowy ideas of the Austrian school can then be turned into statistical

results through a proper method. In this method certain equations of pure theory play a *rôle*; and, without these, the mere statistics will tell us next to nothing. Among these essential relations the simplest is the well known theorem that the marginal utility of, say, food is equal to the marginal utility of money multiplied by the price of food.

Only by such scientific methodology can the statistician get beneath the surface of such empiricism as an "Engel's law," down to a statistical evaluation of a demand or utility curve.

The early astronomers had their analogue of Engel's law. It was called Bode's law, expressing the relative successive distances of the planets from the sun. Today, no astronomer would think of Bode's so-called law as anything more than a rough description or empirical rule. It is not a law comparable with Newton's laws of motion or of gravitation or Kepler's laws of planetary motion.

We can never fulfil statistically those relations found in fundamental economic theory, if we make no use of those fundamental relations in our manipulation of the raw statistical data, any more than an astronomer could compute the orbit of a planet from the fullest data as to angular measurements afforded by his telescope, without using the relation that the planet is attracted by the sun inversely as the square of the distance. In both cases, theory and fact must go hand in hand. Otherwise the world of observation and statistical data will be almost meaningless for lack of any rational framework to fit into, and conversely our theory will be almost meaningless for lack of any statistical expression or verification. We should then have two separate realms of study—a barren set of statistical observations and a barren set of high-spun theories, corresponding to the historical and Austrian schools.

Six years ago Professor Wesley Clair Mitchell in his address as President of the American Economic Association spoke of the fact that a quantitative analysis was not only different from a theoretical analysis but was found to deal with a different set of concepts. Doubtless that is true—in economic statistics. But it ought not to be. As long as it is true we cannot boast of being very scientific.

Other illustrations could be given. The evaluation of the velocity of circulation of money is an example. We talk about it in our courses on economic theory, and used to say it could never be estimated. But it is possible to show that the total circulation of actual physical money in the course of a year is equal to the money deposited in the banks during the year plus the payrolls of the year, plus a number of other but insignificant items. This total circulation divided by the money in circulation is the velocity of circulation. And from this relationship, together with the requisite statistical data, we can derive, not by

empirical correlations but by virtue of the rational theory involved, the statistical result that the velocity of circulation of money in the United States is about twenty-five times a year.

Now that so many able young men, fresh from training in the methods of physical sciences and mathematics, are entering the field of economics and statistics we may expect a gradual disappearance of rank empiricism and arm chair theory alike and a progressive substitution of a rational scientific method for connecting fact and theory. We shall then know our phenomena—that A is true. We shall know, both by *a priori* reasoning and by *a posteriori* testing, our laws—that if A is true, then B must also be true. And finally, from these two sorts of knowledge—namely knowledge of the historical fact that A is true and knowledge of the scientific law that if A is true, then B is true—we can predict in advance that B will be true.

To many all this may seem something new in economics; but it is only an application of something very old in those sciences in whose footsteps we must follow if we are ever to take our place among them as should be our aim and our right.

And as economics does take its rightful place as a science with laws verified by facts and capable of predicting, in some degree, economists will have the satisfaction of feeling that sound economic theory has practical applications, that Hadley's criticisms have been met and that the business man and the statesman are justified in seeking our advice as they seek advice in other fields of science.

Both of these groups of men of affairs are anxious to get quantitative knowledge, to be able to weigh and measure. They need econometrics. In its absence their accountants are fast developing their own methods with a theoretical basis of their own. Incidentally, one of our tasks, already undertaken by Professor Canning, is to connect these results of practical experience in accountancy with economic theory.

In short, what we need in economics, or that branch of economics which we now call economic theory, is more of the old, old method which made astronomy, physics, chemistry, and, recently, biology into true sciences. That goal, as I interpret the rising generation of students of "economic theory," is where they are tending. Moreover they know where they are going. And they are on their way.

ANALYSIS OF VARIANCE AS AN EFFECTIVE METHOD OF HANDLING THE TIME ELEMENT IN CERTAIN ECONOMIC STATISTICS[1]

By Theodore W. Schultz and George W. Snedecor, *Iowa State College*

During the course of an investigation into the geographical distribution of prices paid to producers of swine in Iowa, the usual problems arose concerning the seasonal and secular changes in time series. Some of these problems were solved in an unusually satisfactory manner by the use of the new technique developed by R. A. Fisher[2] and known as *analysis of variance*.

Analysis of variance[3] is not widely used to interpret economic statistics. The reasons are several. The method is new. The technique at first appears complex and students are not familiar with the basic principles underlying the procedure. Naturally, these operate against its application. Because of this it is thought desirable to take an actual problem in economics and indicate the steps that are involved in applying analysis of variance.

The data herein analyzed are the prices paid to producers collected by the Crop Reporting Board of the United States Department of Agriculture. In this monthly survey the price correspondent is asked to report the price of hogs per 100 pounds liveweight in his locality, as of the 15th of the month. The original data are tabulated on a county basis which is, therefore, the smallest geographical unit that can be considered. Each month from 150 to 200 price correspondents have sent to the Crop Reporting Board their estimates of hog prices in their community. These reports are fairly well distributed over the state. Whether or not these data are subject to any bias and their general adequacy, are discussed in considerable detail by Sarle in *Reliability and Adequacy of Farm-Price Data*.[4] Inasmuch as Iowa is strictly a surplus swine area with large numbers of hogs being sold throughout the entire season, the representativeness of these price reports may be accepted with a good deal of confidence.

For the purpose of this study the state was divided into four districts each representing about one-fourth of the area of Iowa. In making the division several factors were considered. For one, districts A and C,

[1] Journal Paper No. B74 of the Iowa Agricultural Experiment Station, Ames, Iowa.

[2] First published in 1923, R. A. Fisher and W. A. Mackenzie, "Studies in Crop Variation, II. The Manurial Response of Different Potato Varieties," *Journal of Agricultural Science*, Vol. 13.

[3] Variance is the square of the standard deviation.

[4] United States Department of Agriculture, Department Bulletin No. 1480, 1927.

TABLE I

IOWA HOG PRICES RECEIVED BY PRODUCERS BY DISTRICTS AND BY MONTHS FOR 1930–31

(Dollars per 100 pounds)

(1)	(1) District	(2) Oct.	(3) Nov.	(4) Dec.	(5) Jan.	(6) Feb.	(7) Mar.	(8) Apr.	(9) May	(10) June	(11) July	(12) Aug.	(13) Sept.	(14) Sums	(15) Means	(16) Sums of squares[a]
(2)	A	8.84	8.04	7.39	7.06	6.44	6.80	6.78	6.03	5.40	6.00	5.91	5.07	79.78	6.65	543.079
(3)	B	8.83	8.23	7.31	7.10	6.62	6.87	6.88	6.10	5.39	5.85	5.66	5.20	80.02	6.67	547.189
(4)	C	8.80	8.17	7.32	7.11	6.63	6.84	6.92	6.08	5.57	6.16	6.24	5.26	81.08	6.76	559.252
(5)	D	8.86	8.45	7.34	7.17	6.65	6.88	6.92	6.30	5.60	6.24	6.36	5.38	82.15	6.85	574.011
(6)	Sums	35.33	32.89	29.36	28.44	26.34	27.39	27.48	24.49	21.96	24.25	24.17	20.91	323.01	....	....
(7)	Means	8.83	8.22	7.34	7.11	6.58	6.85	6.87	6.12	5.49	6.06	6.04	5.23	.....	General Mean 6.73	....
(8)	Sums of squares	312.054	270.526	215.506	202.215	173.477	187.557	188.801	149.984	120.597	147.106	146.351	109.357	.....	....	2,223.531

[a] These sums of squares are calculated, in row 2 for example, as follows:

$$(8.84)^2 + (8.04)^2 \ldots + (5.07)^2 = 543.079$$

which cover the western half of the state, have had blanket freight rates on hogs to Chicago, while the rates within districts B and D were decreasingly less in going from west to east. Then, too, northwest Iowa, district A, produces a heavy lard hog: this area has an abundance of corn, while northeast Iowa, district B, is partly dairying and hogs are not only lighter in weight but also are marketed earlier in the season. Farmers in districts C and D, the southern half of the state, have their sows farrow early. Again, the weight of the swine sold in C and D is considerably less than in A.

Each monthly district price in Table I is the arithmetic mean of the 30 to 50 reports obtained from the counties in that district. The larger the number of price reports appearing in the district-month prices, the greater their stability. This was clearly shown when the study was extended and the state divided into 12 instead of 4 districts. In fact, as the size of the district was decreased there developed an amount of instability greater than could be accounted for by random sampling. Apparently the reason for this lay in the character of the questionnaire which the reporter is requested to fill out. As already indicated, the price correspondent is asked to give the price in his locality of 100 pounds of hogs liveweight. Those familiar with the hog industry know that the actual prices paid for hogs, even in a surplus area like Iowa, cover a wide range, especially in the summer months when both prime hogs and old sows are sold in quantity. This factor could virtually be eliminated if the price correspondent were asked to quote the going price upon a specific grade of hog instead of upon hogs in general. It is by averaging a number of reports that a more representative figure is obtained.

It is apparent from Table I that the downward trend is the chief factor in the variation of these prices. Some variation from district to district occurs, and there is a noticeable irregularity in the manner in which the district prices respond to the general decline in hog prices. The latter, attributable to sampling errors, must be separated from the temporal and geographic variations in order that they may be used as a basis of tests of significance. It is for this purpose that the analysis of variance has been found highly satisfactory.

The necessary calculations are not onerous. The sums of the rows (column 14) add to $323.01, a number which is verified by adding the sums of columns in row 6. In the same manner, the sums of squares of the prices in the several rows total 2223.531. The verification is easily obtained by adding the numbers in row 8.

A "correction term" is now computed thus:

$$\text{Correction term} = \frac{(323.01)^2}{48} = 2{,}173.655.$$

The divisor, 48, is the total number of district-month prices entering into the total, \$323.01.

These are the data from which are calculated the sums of squares in column 3 of Table II. The procedure will now be explained.

TABLE II

ANALYSIS OF VARIANCE OF PRICES PAID TO PRODUCERS OF SWINE IN IOWA, 1930–31

(1) Source of variation	(2) Degrees of freedom	(3) Sums of squares	(4) Mean squares	(5) Standard deviation
Between means of districts	3	0.200	0.066	.....
Between means of months	11	49.205	4.473	.....
Sampling error	33	0.372	0.011	0.105
Total	47	49.876	.....	1.030

First. The total "sum of squares" in the last line of column 3 is

$$2{,}233.531 - 2{,}173.655 = 49.876.$$

This will be recognized as the sum of the squares of the deviations of the 48 prices from the general mean. The number subtracted from the sum of the squares of all the prices is the correction term computed above.

Second. The sum of squares "between means of districts" is

$$\frac{(79.76)^2 + (80.02)^2 + (81.08)^2 + (82.15)^2}{12} - 2{,}173.655 = 0.200.$$

The divisor is the number of prices entering into each of the sums whose squares are added in the numerator. This "sum of squares" is based on the sum of the squares of the deviations of the four district means from their mean, \$6.73.

Third. The sum of squares "between means of months" is

$$\frac{(35.33)^2 + (32.89)^2 \;.\;.\;.\; + (20.91)^2}{4} - 2{,}173.655 = 49.205.$$

The divisor, 4, is again the number of prices entering into each of the sums.

Fourth. The sum of squares attributable to random sampling errors is the difference,

$$49.876 - (0.200 + 49.205) = 0.372.$$

The analysis thus far effected has reduced the total sum of squares to three portions having their sources in (i) actual price differences between districts, (ii) temporal price changes affecting all districts alike, and (iii) sampling errors. This fulfills the requirements set up by Mudgett [1] when he spoke before one of the annual meetings of this Association, "the solution must involve a decomposition of the series into various elements, some of which can be allocated as the effects of specific and important causal forces, and others of which will be classified as random elements in a stable universe."

In the sum of squares between means of months in Table II we have presumably isolated all of those price variations from the general mean which are due to general market forces. In like manner, in the sum of squares between means of districts, we have attempted to include only those price deviations due to the geographical situations of the districts. We assume that the market affected the price of hogs in the several districts simultaneously in the same direction and in like magnitude. It is this aspect of the time element which has been removed. In each of these groups there will always be included variations due to sampling error.

The mean squares in column 4 of Table II are the results of dividing the sums of squares by the corresponding degrees of freedom in column 2. The term "degrees of freedom" has proved puzzling to many readers of Fisher's works. In each line except that containing the sampling error, this number is merely one less than the corresponding number of items going to make up the sum of squares. Thus, in the last line, there are 48 district-month prices, yielding 47 degrees of freedom. This corresponds with "Student's" [2] modification of the standard deviation in which the sum of squares is divided by $n-1$ instead of by n. One way of rationalizing this is to recall that one statistic, the sum (or mean), has been computed from the 48 prices, necessitating a reduction in degrees of freedom from 48 to 47. Another way is to observe that 47 independent comparisons can be made between the prices and the sum (or mean), but that the 48th is then fixed—its value is merely the difference,

$$(\text{sum of 48 prices}) - (\text{sum of 47 prices}).$$

In the case of sampling error, the number of degrees of freedom is the product of those corresponding to district and month

$$3 \text{ times } 11 = 33.$$

[1] Bruce D. Mudgett, "The Application of the Theory of Sampling to Successive Observations Not Independent of Each Other," *Proceedings of the American Statistical Association*, Vol. XXIV, p. 112.

[2] *Biometrika*, London, VI, pp. 1–25, 1908.

This may be explained by a reference to Table I. For each district a sum is computed, leaving only eleven degrees of freedom per district. But also, a sum of four district prices in each month is computed and used in the calculations, leaving only three independent district prices in each of the eleven independent monthly groups.

An essential and most convenient feature of this method of analysis of variance is the additive nature of both the degrees of freedom (column 2) and the sums of squares (column 3). The mean square due to sampling error is frequently referred to as the "interaction." In this sense, it measures the differential response of the several prices to (i) geographical location and (ii) trend in price level. In our problem, this lack of uniformity in response to general conditions is attributed to sampling error. This feature will be discussed more at length later.

The mean squares in column 4 must be given particular attention—they, in fact, constitute the analysis desired. If the entire series of 48 district-month prices had been drawn at random from a homogeneous normal population, these mean squares would differ only by the small amounts due to random variation, and each one would be an unbiased and independent estimate of the variance in the population. In our example, this is not the case. Only the mean square attributed to sampling error furnishes such an estimate. The others, being so different from this, indicate heterogeneity in the population sampled. Both geographic location and changes in prices during time have introduced variability. These sources of variation have now been effectively isolated from the sampling error.

The standard deviation of the 48 district-month prices before isolating the heterogeneity due to temporal changes and to variation between districts was,

$$\sqrt{\frac{49.876}{47}} = \$1.030 \text{ per 100 lbs. liveweight.}$$

After elimination of known sources of variation, the standard deviation attributed to sampling error is

$$\sqrt{0.011} = \$0.105 \text{ per 100 lbs. liveweight.}$$

This number may be used in the usual manner to test the significance of the various differences between means of months and means of districts. For example, the standard deviation of the mean difference between any pair of districts is given by the usual formula,

$$\sqrt{\frac{0.011}{12} + \frac{0.011}{12}} = 0.105\sqrt{\frac{2}{12}} = \$0.041.$$

However, a much more general and appropriate method of testing is furnished by Fisher's test of the significance of the statistic z, defined as one-half the natural logarithm of the quotient of any two such mean squares as those in Table II. With a slight modification, common logarithms may be used as in the following example: It is required to determine whether or not the mean square between means of districts (0.099) is significantly greater than that due to sampling error (0.011). We have,

$$\log. 0.099 = 8.9956 - 10$$
$$\log. 0.011 = 8.0414 - 10$$
$$\text{Difference} = 0.9542$$
$$z = (0.9542)(1.1513) = 1.0986$$

The multiplier, 1.1513 ($=\frac{1}{2}$ of 2.3026) effects the division by 2 as well as the transformation to natural logarithms.

The distribution of the statistic, z, depends on the number of degrees of freedom, n_1, corresponding to the larger of the two mean squares as well as the number, n_2, corresponding to the smaller. Fisher[1] gives two tables of z, one tabulating the values which will be reached or exceeded in 5 per cent of samples drawn from a homogeneous population, the second, the values reached or exceeded by only 1 per cent of such samples. In the example above, $n_1=3$ and $n_2=33$. The 5 per cent value of z is, by interpolation, 0.5333, while the 1 per cent value is 0.7487. Since the value of z computed from the price data is larger than either, *it is said to be highly significant*—*it would arise by chance* less than once in a hundred samples drawn from a homogeneous population. The conclusion from this evidence is that geographic situation introduces heterogeneity into the producers' prices. The district means differ significantly among themselves.

In a very rough way it may be said that if one mean square is from three to ten times greater than another then it is significantly greater. Since the mean square due to differences between means of months is more than 400 times that due to sampling error, there is no point in testing for significance. The general price changes from month to month, affecting all districts, are the outstanding source of heterogeneity in producers' prices.

One may gain additional insight into the mechanism of analysis of variance by applying the method to the special case in which only two series of district prices are considered. For example, in Table III are exhibited the producers' prices for districts A and D. A standard

[1] R. A. Fisher, *Statistical Methods for Research Workers*, 3rd ed. rev. and enl., Oliver and Boyd, 1930. Table VI, pp. 212–215.

method would be to compute the twelve monthly differences between the district prices. The mean of these differences is \$0.199 with standard error, \$0.043.

TABLE III

IOWA HOG PRICES RECEIVED BY PRODUCERS FOR DISTRICTS A AND D BY MONTHS FOR 1930-31

(Dollars per 100 pounds)

District	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
A.	8.84	8.04	7.39	7.06	6.44	6.80	6.78	6.03	5.40	6.00	5.91	5.07	79.76
D.	8.86	8.45	7.34	7.17	6.65	6.88	6.92	6.30	5.60	6.24	6.36	5.38	82.15
Total.	17.70	16.49	14.73	14.23	13.09	13.68	13.70	12.33	11.00	12.24	12.27	10.45	161.91

Since the mean is more than four times its standard deviation, there can be little doubt as to the heterogeneity introduced into producers' prices by geographic locality. While analysis of variance is not an efficient method for treating this simple type of statistics, the results are exhibited in Table IV for the sake of comparison.

TABLE IV

ANALYSIS OF VARIANCE OF PRICES PAID TO PRODUCERS OF SWINE IN TWO DISTRICTS OF IOWA, 1930-31

Source of variation	Degrees of freedom	Sums of squares	Mean squares
Between means of districts.	1	.238	.238
Between means of months.	11	24.444	2.222
Sampling error.	11	.123	.0112
Total.	23	24.805	. . . . . .

The mean square due to district differences is more than 20 times that due to sampling error, so there is no question as to significance. Instead of testing z, therefore, it is of interest to compute the standard error of the mean difference. This is

$$\sqrt{\frac{.0112}{12}+\frac{.0112}{12}}=\$0.043,$$

the same result as that obtained in the standard method. This shows that analysis of variance is just as effective in eliminating the effect of temporal changes in prices as the method of differences. The distinct gain of analysis of variance comes when more than two sets of differences are being simultaneously investigated.

After completing the analysis of variance given in Table II, the study was extended to cover seven years. The period from October, 1924, to September, 1931, was treated as one sample and again the

TABLE V

IOWA HOG PRICES PAID TO PRODUCERS BY DISTRICTS, 1924–25 TO 1930–31

(Dollars per 100 pounds)

District	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Sum	Sum of squares
1924–25														
A	9.89	8.39	8.16	9.58	9.94	12.61	12.29	11.28	11.18	12.56	12.28	11.17	129.51	1,425.571
B	10.11	8.49	8.09	9.50	9.64	12.38	12.38	10.90	11.18	12.62	12.40	11.55	129.24	1,469.678
C	10.22	8.84	8.40	9.33	9.74	11.51	11.93	11.33	10.99	12.35	12.37	11.53	128.54	1,397.505
D	10.60	8.38	8.51	9.62	9.78	12.40	12.47	11.54	11.32	12.64	12.63	11.89	131.76	1,473.998
1925–26														
A	10.54	10.12	10.08	10.78	11.78	11.54	11.37	11.81	13.03	12.12	11.12	11.42	135.71	1,542.760
B	11.12	10.41	10.23	10.92	11.82	11.78	11.59	12.06	13.00	12.74	10.92	11.71	138.30	1,601.852
C	10.91	10.42	10.14	10.96	11.78	11.73	11.44	12.09	13.08	12.77	11.20	11.90	138.42	1,605.158
D	11.29	10.56	10.32	10.89	12.22	12.12	11.38	12.26	13.14	13.24	11.89	12.24	141.53	1,678.799
1926–27														
A	11.53	11.20	10.68	10.74	11.23	10.78	10.06	9.07	7.80	8.29	8.74	9.53	119.65	1,210.353
B	12.05	11.17	10.91	11.14	11.34	10.97	10.38	9.15	8.04	8.12	8.74	9.31	121.32	1,247.141
C	11.60	10.90	10.68	10.89	11.14	10.89	10.21	9.24	8.03	8.25	9.03	9.56	120.42	1,223.816
D	12.30	11.50	10.90	11.15	11.39	11.10	10.42	9.35	8.06	8.41	9.24	9.97	123.81	1,296.407
1927–28														
A	10.21	8.97	7.72	7.54	7.33	7.26	7.76	8.89	8.78	9.92	10.13	11.68	108.17	961.024
B	10.01	8.71	7.83	7.68	7.48	7.42	7.86	9.02	8.81	9.67	10.10	11.50	106.07	935.581
C	10.32	8.71	7.90	7.76	7.40	7.42	7.76	8.49	8.93	9.87	10.04	11.58	106.18	959.168
D	10.29	8.85	7.89	7.75	7.56	7.53	7.82	9.18	8.86	10.13	10.45	11.79	108.10	995.124
1928–29														
A	9.48	8.41	7.91	8.14	9.14	10.57	10.65	10.36	9.95	10.64	10.35	9.37	114.97	1,112.574
B	9.46	8.13	7.85	8.28	9.03	10.61	10.53	10.20	9.66	10.47	10.34	9.46	114.22	1,098.051
C	9.47	8.43	7.79	8.12	9.00	10.44	10.56	10.07	9.97	10.70	10.34	9.40	114.29	1,099.443
D	9.56	8.44	7.96	8.24	9.10	10.49	10.67	10.14	10.03	10.54	10.56	9.51	115.24	1,117.051
1929–30														
A	8.79	8.32	8.58	8.79	9.84	9.75	9.20	9.12	9.16	8.24	8.22	9.52	107.53	967.072
B	8.98	8.30	8.50	8.69	9.59	9.61	9.22	9.10	9.17	8.11	8.52	9.52	107.51	968.401
C	8.90	8.34	8.44	8.71	9.63	9.78	9.26	9.06	9.14	8.31	8.68	9.64	107.89	972.947
D	9.15	8.53	8.54	9.02	9.82	10.10	9.42	9.26	9.33	8.60	8.75	9.73	110.25	1,015.946
1930–31														
A	8.84	8.04	7.39	7.06	6.44	6.80	6.75	6.03	5.40	6.00	5.91	5.07	79.78	543.079
B	8.83	8.23	7.31	7.10	6.62	6.57	6.88	6.10	5.39	5.55	5.66	5.20	80.02	547.189
C	8.80	8.17	7.32	7.11	6.63	6.84	6.92	6.06	5.57	6.16	6.24	5.26	81.08	559.252
D	8.86	8.45	7.34	7.17	6.65	6.88	6.92	6.30	5.60	6.24	6.36	5.38	82.15	574.011
Total													3,199.64	31,566.949

variations were separated into three components: (i) between means of districts, (ii) between means of months, and (iii) sampling error.

Except for the fact that there are now 84 instead of 12 months the steps involved in obtaining the required calculations are identical with those already described. The arithmetic therefore need not be included. The analysis of variance is shown in Table VI.

TABLE VI

ANALYSIS OF VARIANCE FOR PRICES PAID TO PRODUCERS OF SWINE IN IOWA, 1924-25 TO 1930-31

Source of variation	Degrees of freedom	Sums of squares	Mean squares	Standard deviation
Between means of districts	3	2.748	0.916	....
Between means of months	83	1,089.015	13.121	....
Sampling error	249	6.852	0.024	.155
Total	335	1,097.615	......	1.810

Upon increasing the number of months from 12 to 84 the mean square for "between means of districts" increased from 9 times to 38 times the size of the mean square for sampling error. The standard error of the difference between any two district means is reduced from \$.041 to \$.024 cents per 100 pounds, a reduction of slightly more than 40 per cent. Therefore, it is evident that the relative significance of the geographic variations in swine prices is greatly enhanced by extending the analysis to include seven years.

From the data in Table V it is possible to obtain some important additional information. By analysis of variance, it is possible to determine whether or not the intraseasonal and interseasonal movements of hog prices had any effect upon the price differentials between districts. To the student of prices these two relationships are of special importance. He wants to know: (i) Did the price differentials between districts vary significantly within the production year, which in Iowa runs from October to September; and (ii) did they behave differently in some years than in others? The first of these questions deals with the influence of the intraseasonal and the second with the interseasonal movement of hog prices upon their geographical pattern. Table VII, which gives the means of the 7 Octobers, 7 Novembers, etc. for each district, is based on Table V. What assurance is there that the differences between the means in Table VII are not the result of sampling error?

The intraseasonal analysis involves measuring the interrelation prevailing among the means of the 7 Octobers, 7 Novembers, etc., of the 4 districts. As noted above, the interrelation of two factors is called

TABLE VII

SEASONAL VARIATIONS IN THE AVERAGE PRICE OF HOGS PAID TO PRODUCERS IN IOWA, BY DISTRICTS, 1924-25 TO 1930-31

(Dollars per 100 pounds)

Months	Districts				
	A	B	C	D	D minus A
October	9.90	10.08	10.03	10.29	.39
November	9.06	9.06	9.12	9.24	.18
December	8.64	8.67	8.66	8.78	.14
January	8.94	9.04	8.98	9.12	.18
February	9.38	9.30	9.33	9.50	.12
March	9.93	9.98	9.80	10.09	.16
April	9.73	9.83	9.72	9.87	.14
May	9.51	9.50	9.48	9.72	.21
June	9.32	9.36	9.39	9.48	.16
July	9.69	9.65	9.77	9.87	.20
August	9.53	9.52	9.70	9.98	.45
September	9.68	9.75	9.84	10.07	.39
Average	9.44	9.48	9.50	9.68	.24

interaction. The corresponding sum of squares may be isolated in the same manner as was the component—sampling error—in the example given above. The price variations due to interaction would be zero if the price differentials between districts were the same for the 7 Octobers, 7 Novembers, etc. If the interaction is no greater than is to be expected from sampling error it is adjudged non-significant.

To isolate the interaction: (i) Between districts and months and (ii) between districts and years, the following calculations are necessary.

$$\text{The correction term} = \frac{(3199.64)^2}{336} = 30,469.334.$$

The sum of the squares of the 336 district-month prices appearing in Table V is 31,566.949.

(1) The total sum of squares of the deviations from the general mean therefore, is,

$$31,566.949 - 30,469.334 = 1,097.615.$$

(2) In calculating the sum of squares for "between means of districts" the block table on page 25 is helpful.

The first figure in the upper left-hand corner, 69.28, is the sum of the 7 October prices in district A, the next to the right the sum of the Novembers, and so on. The sum of squares for "between means of districts" is,

$$\frac{(793.30)^2+(796.08)^2+(796.82)^2+(812.84)^2}{84} - 30,469.334 = 2.748.$$

DISTRICTS BY MONTHS (7 YEARS)

Districts	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
A....................	(7) 69.28	63.45	60.52	62.63	65.70	69.51	68.11	66.56	65.29	67.77	66.73	67.76	(84) 793.30
B....................	(7) 70.56	63.44	60.72	63.29	65.52	69.84	68.82	66.53	65.45	67.58	66.68	68.25	(84) 798.68
C....................	(7) 70.22	63.81	60.67	62.88	65.32	68.61	68.06	66.34	65.71	68.41	67.90	68.57	(84) 796.82
D....................	(7) 72.05	64.69	61.46	63.84	66.52	70.62	69.08	68.03	66.36	69.80	69.88	70.51	(84) 812.84
Total....................	(28) 282.11	255.39	243.37	252.64	263.06	278.58	274.09	267.46	262.80	273.56	271.19	275.39	(336) 3,199.64

The number 84 is used as the divisor because there are that many monthly district prices in each term of the numerator.

(3) For "between means of months,"

$$\frac{(282.11)^2+(255.39)^2 \;.\;.\;.\; +(275.39)^2}{28}-30,469.334=52.672.$$

(4) Interaction between districts and months,

$$\frac{(69.28)^2+(63.45)^2 \ldots +(70.51)^2}{7}-(30,469.334+2.748+52.672)=1.056.$$

This second block table facilitates the calculation of the sums of squares for "between means of years" and interaction between districts and years. Note that the final column is a check on the sums for districts already used.

DISTRICTS BY YEARS (12 MONTHS)

Districts	1924–25	1925–26	1926–27	1927–28	1928–29	1929–30	1930–31	Total
A.	(12) 129.51	135.71	119.65	106.17	114.07	107.63	79.70	(84) 793.80
B.	(12) 129.24	138.30	121.32	106.07	114.22	107.61	80.02	(84) 796.08
C.	(12) 128.54	138.42	120.42	106.18	114.20	107.80	81.08	(84) 796.82
D.	(12) 131.76	141.53	123.81	108.10	116.24	110.26	82.15	(84) 812.84
Total.	(48) 519.05	553.96	485.20	426.52	458.72	433.18	323.01	(336) 3,199.64

(5) For "between means of years,"

$$\frac{(519.05)^2+(553.96)^2 \;.\;.\;.\; +(323.01)^2}{48}-30,469.334=697.903.$$

(6) Interaction between districts and years,

$$\frac{(129.51)^2+(135.71)^2 \;.\;.\;.\; +(82.15)^2}{12}-(30,469.334+2.748+697.903)=$$

$$1.006.$$

The final block table given below aids in computing the interaction between years and months. The final column and row again verify the sums for months and years used in the preceding computations.

YEARS BY MONTHS (4 DISTRICTS)

Months	1924-25	1925-26	1926-27	1927-28	1928-29	1929-30	1930-31	Total
	(4)							(28)
October	40.82	43.86	47.48	40.81	37.97	35.82	35.33	282.11
November	31.08	41.51	44.77	35.24	34.41	34.49	32.89	255.39
December	33.16	39.77	44.17	31.34	31.51	34.06	29.36	243.37
January	38.03	43.55	44.02	30.71	32.78	35.21	28.44	252.64
February	39.10	47.60	45.10	29.77	30.27	38.88	26.74	241.06
March	49.10	47.17	43.74	29.61	42.11	39.44	27.39	278.56
April	49.07	45.70	41.07	31.20	42.41	37.10	27.48	274.09
May	45.05	48.22	36.81	35.58	40.77	36.54	24.49	267.46
June	44.67	52.25	34.95	35.30	39.81	36.80	21.96	262.80
July	50.17	50.87	34.07	39.50	42.35	37.26	24.25	273.56
August	49.60	45.11	35.75	40.72	41.59	34.17	24.17	271.19
September	40.14	47.27	38.37	40.55	37.74	38.41	20.91	275.39
Total	(48) 510.05	551.90	485.20	420.52	468.72	433.18	323.01	(336) 3,190.64

(7) Interaction between years and months,

$$\frac{(40.82)^2+(43.86)^2 \;.\;.\;.\; +(20.91)^2}{4}-(30,469.334+697.003+52.672)=$$

$$338.440.$$

(8) For sampling error,

$$1097.615-[(2)+(3)+(4)+(5)+(6)+(7)]=3.790.$$

TABLE VIII

ANALYSIS OF VARIANCE FOR PRICES PAID TO PRODUCERS OF SWINE IN IOWA ARRANGED TO ISOLATE INTRASEASONAL AND INTERSEASONAL PRICE EFFECTS, 1924-25 TO 1930-31

Source of variation	Degrees of freedom	Sums of squares	Mean squares	Standard deviation
Between means of districts	3	2.748	0.916	....
Between means of years	6	697.003	116.167	....
Between means of months	11	52.672	4.788	....
Interactions:				
Districts and years	18	1.080	0.060	....
Districts and months	33	1.056	0.032	....
Years and months	66	338.440	5.128	....
Sampling error	198	3.790	0.019	.138
Total	335	1,097.615	....	1.810

There is a total of 336 district-month prices in Table V which provide 335 independent comparisons and therefore yield 335 degrees of freedom. Similarly, 4 districts involve 3 degrees of freedom for the comparison between districts; 7 years provide 6 independent comparisons between years, hence 6 degrees of freedom; and, in the same way, 12 months give 11 degrees of freedom.

There are 3 independent district differences and for each of these the 7 years provide 6 independent comparisons or,

3 times 6 = 18 degrees of freedom.

Thus, 18 degrees of freedom are permitted for the interaction that arises from the different manner in which the district means vary from year to year. In a like manner, the interaction between districts and months gives,

$$3 \text{ times } 11 = 33 \text{ degrees of freedom.}$$

The interaction between years and months involves

$$6 \text{ times } 11 = 66 \text{ degrees of freedom.}$$

The degrees of freedom for sampling error are equal to the remainder,

$$335 - (3 + 6 + 11 + 18 + 33 + 66) = 198.$$

This figure may also be computed by multiplying the degrees of freedom for districts, years and months; that is,

$$3 \text{ times } 6 \text{ times } 11 = 198 \text{ degrees of freedom.}$$

As before, the mean squares in Table VIII are the important summary expressions of the analysis. The interaction between districts and months provides a measure of the influence of the intraseasonal price changes upon the price differentials that prevailed between the 4 districts. What is the statistical significance of the interaction? We have,

$$\begin{aligned} \log.\ .032 &= 8.5052 - 10 \\ \log.\ .019 &= 8.2788 - 10 \\ \text{Difference} &= 0.2264 \end{aligned}$$

$$\text{Calculated } z = (0.2264)(1.1513) = 0.2607.$$

By interpolation the 1 per cent point in Fisher's table for $n_1 = 33$ and $n_2 = 198$ is found to be approximately 0.2318. The calculated z is slightly larger and therefore we conclude that the interaction between districts and months is highly significant. This means that the intraseasonal movement of hog prices had different effects upon Iowa swine prices in the four districts. The changes in the differences of the prices in districts A and D are shown in the last column of Table VII.

Since each district-month mean in Table VII is the average of 7 Octobers, 7 Novembers, etc., its standard error becomes,

$$\sqrt{\frac{.0191}{7}} = \$.052 \text{ per 100 pounds.}$$

For the price difference between any two month-district means, for instance, those appearing in the last column of Table VII, the standard

error is equal to,

$$\sqrt{\frac{.0191}{7}+\frac{.0191}{7}}=\sqrt{\frac{.0191}{7}}\cdot\sqrt{2}=\$.074 \text{ per 100 pounds.}$$

We may therefore say with considerable confidence that prices paid for swine in southeastern Iowa, district D, were from 30 to 45 cents above the remainder of the state during the summer and early fall while during the rest of the year this price spread between district D and the other districts stood from 15 to 20 cents a 100 pounds in favor of the southeastern counties.

The mean square for the interaction between districts and years is tested for significance as follows:

$$\begin{aligned}\log.\ .056 &= 8.7482-10\\ \log.\ .019 &= 8.2788-10\\ \text{Difference} &= 0.4694\end{aligned}$$

$$\text{Calculated } z=(0.4694)(1.1513)=0.5404.$$

With $n_1=18$ and $n_2=108$, Fisher's tabular z at the 1 per cent point is about 0.3480. Inasmuch as our calculated z of 0.5404 is considerably larger than the 1 per cent value, we conclude that the price heterogeneity isolated in the interaction between districts and years is also highly significant.

Since there are 12 district-month prices in each district-year mean appearing in Table IX, the standard error of any district-year mean is

$$\sqrt{\frac{.0191}{12}}=\$.039 \text{ per 100 pounds.}$$

And the standard error for the price difference between any two district-means for any year is,

$$\sqrt{\frac{.0191}{12}}\cdot\sqrt{2}=\$.056 \text{ cents per 100 pounds.}$$

The importance of the interaction of districts and years is shown in Table IX. The price differentials of southeast Iowa over northwest Iowa virtually ranged from 50 cents a 100 pounds in 1925–26 to zero in 1928–29. The variations in the year to year price differentials between districts D and A are to be explained principally in the differences in the weight of hogs sold. Northwest Iowa markets a much heavier hog than southeast Iowa. As a result the two districts reflect the market premiums and discounts of their respective hog weights. For example, in 1925–26 light hogs sold at the highest premium over heavy

TABLE IX

AVERAGE ANNUAL PRICE OF HOGS PAID TO PRODUCERS IN IOWA, BY DISTRICTS, 1924-25 TO 1930-31

(Dollars per 100 pounds)

Year	District				
	A	B	C	D	D minus A
1924-25	10.70	10.77	10.84	10.80	.10
1925-26	11.31	11.52	11.54	11.79	.48
1926-27	9.97	10.11	10.01	10.32	.35
1927-28	8.85	8.84	8.84	9.01	.16
1928-29	9.58	9.52	9.52	9.60	.02
1929-30	8.96	8.96	9.16	9.19	.23
1930-31	6.65	6.67	6.76	6.85	.20
Average	9.44	9.48	9.56	9.68	.24

hogs since 1920, while during most of 1928-29 they actually sold for more than the lighter weights.

The economic results of this investigation are briefly: (i) It was found that the prices paid to producers in Iowa for swine were roughly 25 cents higher in southeast Iowa than in the remainder of the state; (ii) the price differentials between districts showed a very definite seasonal movement. From October through June they stayed fairly constant but widened materially during the summer and early fall months; and (iii) the price differentials due to geographic situation changed significantly from one year to another.

Summarizing, the advantages of the analysis of variance technique are: (i) It affords a strict mathematical procedure by which a great bulk of complex data may be readily reduced to a few summary expressions, i.e. the mean squares in the analysis of variance table; (ii) the arithmetic required to reduce the data first to sums of squares and then to mean squares is materially simplified compared with more common methods; (iii) it is in harmony with the theory of small samples first established by "Student"—the adjustment made by using the appropriate number of degrees of freedom; (iv) the method provides an exact test of significance in the z distribution developed by R. A. Fisher; and (v) it is the only efficient technique by which it is possible to isolate the heterogeneity and interpret the significance of a number of components simultaneously.

CONSTRUCTION STATISTICS

By Corrington Gill, *Federal Employment Stabilization Board*

The discussions and debates leading up to and following the passage of the Emergency Relief and Construction Act of 1932 indicate the lack of specific and accurate information available in this country on the subjects of construction and employment in construction.

Estimates of the volume of construction during any period of time are subject to wide divergence of opinion. This is particularly true with reference to the volume of work currently undertaken by the different types of constructing agencies. The number of men employed directly and indirectly in the construction industries must be estimated roughly. Considering the lack of accurate information, it is not surprising that even official estimates of employment per dollar of public expenditure for construction vary so markedly.

The possibility of stabilizing the construction industry by timing public construction operations inversely with the private building cycle invariably involves problems of financing both public and private construction operations. On this subject also, the available statistical data are meager.

Public officials, as well as private industry, must depend on available evidence for their opinions, and the validity of these opinions will depend upon the completeness and accuracy of the existing statistical data. The following outline of available current construction statistics is an attempt to evaluate their worth by describing sources of information and the methods of compilation.

VOLUME OF CONSTRUCTION

Ideally, we should have an exact measurement of the physical volume of construction activity under way at all times. Unfortunately, such information is not available. We do have data, however, which can be used in estimating roughly the dollar volume of construction. These are, first, construction contracts awarded as reported by the F. W. Dodge Corporation and other services; second, building permits, as compiled by practically all cities, and third, cross section studies such as the Census of Construction of 1929. When an attempt is made to reduce these dollar data to physical terms, the availability of only imperfect data on construction costs constitutes a serious obstacle to estimating physical volume. Each of these three types of volume data is important, but unfortunately all three have defects. A brief description of the three types follows:

CONTRACTS AWARDED

DODGE STATISTICAL RESEARCH SERVICE. The F. W. Dodge Corporation was organized more than forty years ago to gather and disseminate information to the construction industry. The statistical reports, now a part of the Dodge Statistical Research Service, record construction contracts awarded since 1919. The reports have shown a consistent improvement from year to year. At the present time, they publish tri-monthly and monthly comprehensive data of contracts awarded for the 37 eastern states, broken down by value, number of projects, square feet, and types of construction. Historically, contract data on total construction in the New England States by months date back to January, 1901. From January, 1919, to April, 1921, their reports included data for 25 states east and north of and including North and South Dakota, Iowa, Missouri, Tennessee and Virginia, together with the District of Columbia and portions of Kansas and Nebraska. Beginning with May, 1921, figures for North and South Carolina were added and in January, 1923, reporting services were started in Florida, Georgia, Alabama, Mississippi, Louisiana, Arkansas and Oklahoma.

The Dodge Service covers not only contracts awarded, but also some work performed for owners by force account or day labor when reported by the Dodge representatives. The Service does not cover over 25 per cent of the construction and maintenance work of the railroads and public utilities, however. How important these latter expenditures are is seen from the fact that they amounted to over four billion dollars in 1930, and almost three billion dollars in 1931.

Even though the Dodge contract data are the most reliable for judging the volume of construction, certain limitations should be noted.

. Data on contracts awarded do not measure the physical volume of construction work actually under way, as the award of the contract precedes the peak of activity on the project by an indefinite period of time. (Three months average lead probable.)

Classification of construction work has proved to be a very difficult problem, as is clearly indicated by the fact that the Dodge Corporation has found it necessary to change its classifications and groupings several times in the last few years. The shifting of interest is partially responsible for this changing classification. This is illustrated by the Dodge Service's recent segregation of public works and public utilities into two groups so that public utilities and public works data are now available separately.

The Dodge data have included contracts on alterations and repairs since January, 1932, which tend to limit their value in measuring new

construction. Dodge officials state that the broadened base does not seriously affect the comparability of the series over the entire period.

The Dodge data on contracts awarded were formerly limited to contracts of $5,000 or more. Beginning with 1932, their reports are for all contracts regardless of amount, exclusive of farm construction.

The Dodge contract information is gathered by reporters in the field, and the number of reporters varies from time to time. However, it is believed that the statistical service, being based as it is on a daily report service to contractors, building supply people, architects and others, is reliable for what it purports to cover, i.e., number of projects, number of square feet when possible to estimate, and the value of the contracts awarded in the 37 eastern States.

THE ENGINEERING NEWS-RECORD.—This publication reports weekly on engineering contracts only, as reported to them by correspondents in the field. This series appears to contain most of the public contracts awarded, as well as a high percentage of engineering contracts awarded. In the summer of 1932, the minimum contract price to be reported was lowered and consequently there is some possibility that the series after July will not be comparable to the series before that date. This change in minimum was made in an effort to adjust the dollar volume of contracts awarded to the lowered cost of construction. As costs started to fall three years before this change in minimum was made, the adjustment will not be effective during that period. The *Engineering News-Record* compilation of contracts awarded is broken down into six geographic areas, and by seven types of public construction and five types of private construction.

MISCELLANEOUS.—Several publications report on contracts awarded in their circulation area. These reports are usually incomplete and are not tabulated. Among periodicals publishing such information are the *Western Construction News*, the *Pacific Builder and Engineer*, the *Manufacturers Record*, the *Daily Journal of Commerce of Seattle and Portland*, and the *Dow Service* of New York City.

The Bureau of Labor Statistics began in December, 1930, to compile information on contracts awarded by the Federal Government. Since inaugurating this new series, it has reported on the awards made by the Architect of the Capitol, Office of the Quartermaster General of the War Department, Bureau of Yards and Docks of the Navy Department, Supervising Architect of the Treasury Department, the United States Veterans' Bureau and the Office of Public Parks and Public Buildings. (These agencies perform less than 50 per cent of Federal construction.)

The Bureau also reports on contracts awarded by state governments by months since the beginning of 1931. These reports are too incom-

plete to be of any value representing as they do less than 25 per cent of the construction contracts awarded by the states.

Building Permits

Obtaining a permit to build is made mandatory by law in most cities and theoretically at least a compilation of these building permits should indicate the volume of urban construction. For this reason many organizations have spent considerable time and effort in compiling time series of building permits issued in various cities. Such series now available are:

FEDERAL RESERVE BOARD.—This series covering building permits on a monthly basis begins with 166 identical cities in 1920, covers 167 cities from January, 1921, through September, 1921, and 168 cities from October, 1921, to date. These data provide the longest time series available by months on building permits.

THE COMMERCIAL AND FINANCIAL CHRONICLE.—This compilation is on an annual basis and is published each January in two separate series—first, annual totals from 1916 to date for 310 identical cities and the same tabulation plus 44 additional cities (total of 354) beginning with January, 1924. This annual tabulation is published for cities and states under the general heading of "Building Operations." Previous to 1916, the *Chronicle* published permit data covering a varying number of cities as far back as 1909, at which time permit values in 163 cities were given.

BUREAU OF LABOR STATISTICS.—The Bureau publishes information on building permits issued in the principal cities of the United States monthly. The number of cities varies from month to month. The Bureau's tabulation is the most comprehensive available on the subject of building permits issued in cities having a population of over 25,000. Data are available from 257 identical cities on an annual basis since 1921, and from 130 cities from 1914 through 1926. Their annual tabulation shows the estimated expenditures for new residential buildings, new non-residential buildings, total new buildings, alterations, additions and repairs, the number of families provided for, the ratio of families provided for to each 10,000 of population, an index number for each of these items, an index number of families provided for, weighted by population, and an average cost per family unit each year by type of building.

Beginning with September, 1920, the Bureau has been collecting and publishing monthly information in the same form as their annual material.

Since 1930 the Bureau has attempted to include public works (city,

state and Federal) in its compilation to remedy one of the most patent omissions in building permit data. This correction is not complete, however, as the Bureau's information on public works contracts is too incomplete to raise its building permit figures materially.

BRADSTREET'S.—Bradstreet has compiled, since 1909, annual series on building permits. Two separate series are available from this source—first, one containing data from 55 identical cities from 1905 to 1913, and second, another series containing data from 120 cities from 1909 to date. Bradstreet also publishes monthly information on building permits on non-identical cities which is comparable for only limited periods of time.

S. W. STRAUS AND COMPANY.—Although their report each month contains the data from the largest number of cities (over 600 in 1932) this source does not publish a series based on identical cities over a long period of time. Each issue of their *National Monthly Building Survey* contains permit data for that month, the previous month and the same month a year ago.

Favorable factors in the use of building permit data as a measurement of future building operations are:

These data are available on an annual basis from identical cities for a comparatively long period of time (Carl Snyder compiled an annual series covering 7 cities from 1882 to 1900 and Colonel Ayres covering 50 cities, 1900–21) and can be used to some extent in measuring long time trends.

Permit data are taken from city records required by law and are therefore more dependable than reporters in the field who may miss many projects.

The Bureau of Labor Statistics data measure the relationship between dollar expenditure and the number of families provided for.

The *unfavorable factors* are:

Data for different cities are not strictly comparable as the amounts recorded depend upon local ordinances varying as to the basis on which the building permit amount is based. In some localities the values of permits issued are constantly low, which is evidence of the effect of assessment laws on permit figures.

New York City and Boston do not require building permits. In these two cities local ordinances provide that "plans" must be filed. All of the series of permit information mentioned above include these two cities even though "plans filed" are not similar in meaning to "permits granted."

Permits do not measure suburban building. As much of the con-

struction during the years 1925 to 1928 took place outside city limits, building permits receded each year during this period in contrast to contracts awarded which reached their peak in 1928.

As permits total about half the contracts-awarded figure, they can be regarded as but half as good a sample as the contract data.

Permits do not measure engineering work, public work (generally speaking) and very little of the construction activity of the railroads and public utilities.

The fact that building permits may be granted and the work postponed indefinitely or even abandoned makes the permit data of dubious value if one wishes to measure the volume of construction work.

All permit series, except the Bureau of Labor Statistics "families provided for," are based on dollar value and have therefore the shortcomings of all such series during periods of changing construction costs as they fail to measure during such time the physical volume of construction. This would not be as important as it is were it possible to obtain a reliable index of building costs which could be used to deflate such a series. Unfortunately, however, this is impossible at the present time.

The chief exponent of building permit data as a measure of building operations is the *Commercial and Financial Chronicle*. It justifies this (January 30, 1932) by saying

> . . . we are inclined to think that the building figures which we and a few others undertake to collect furnish a better indication of the course of new building work than the records of contracts awarded, though it is not to be denied that these latter have a peculiar value of their own. In the first place, building permits deal with distinctively building work, and, in the second place, inasmuch as they represent projected work more largely than work actually begun, they are a much more valuable indication of intentions with respect to the immediate future. When award of a contract has been made, it almost invariably means that work will commence close upon the heels of the award. Not so when a plan is filed for a new building or for building work. Numerous considerations may, and often do, intervene to postpone the actual carrying out of the plans, and in most cases the contract for the work still remains to be awarded at some near or remote date. Thus it is unmistakably true that *intentions* with respect to new building work are more clearly and more definitely reflected by the building permit figures than by the other figures referred to.

All of the evidence available indicates that for the purpose of measuring the volume of construction nationally, the contracts-awarded data are far superior to building permits, although detailed data for individual cities are an aid in studying local building facts, and to some extent, an aid in estimating the building trend for the years preceding the inauguration of the Dodge Statistical Service.

Shipment of Building Materials

One of the best methods of estimating relative changes in the physical volume of construction is through the use of an index based on the shipments of construction materials from the factory to the job. It has been found that shipments follow the award of construction contracts by about two months and precede the employment of men in the field by about one month.

Shipment indexes have the advantage of being expressed in terms of physical volume rather than in dollars. Then, too, it is possible to make a rough test every two years with the Census of Manufacturers' data to insure the indexes against a fatal secular bias.

THE FEDERAL EMPLOYMENT STABILIZATION BOARD'S INDEX OF SHIPMENTS OF CONSTRUCTION MATERIAL.—This index contains thirty-one separate series each representing the shipment of a material used in construction. Each series has been studied to be sure that the source is reliable and that in practically every series the data represent reports from establishments producing at least 75 per cent of that particular material. The composite series begins January, 1925, and is the only index on the shipment of construction materials since the *Constructor* ceased compiling its shipment index in May, 1932.

THE INTERSTATE COMMERCE COMMISSION.—A statement of freight loadings for different commodities is published each quarter by the Interstate Commerce Commission, Bureau of Statistics. These statements show car loadings during the quarter of some twenty-one materials used in construction operations. The data begin with 1920. Between the years 1927 and 1928 a change was made in the classification of these commodities and it is necessary to make an adjustment between the first and second periods in compiling an index of these railroad shipments. These data confirm the Federal Employment Stabilization Board's index of factory shipments, but are not considered as practical because, first, they do not include shipments by water or truck; second, because they are on a quarterly basis; and third, because the information is not available as currently as the Board's monthly index.

Cross Section Studies

The information that has been discussed previously is in the form of time series. Another method of estimating the volume of construction for a given period of time is through the taking of a census.

CENSUS OF CONSTRUCTION.—After years of effort, contractors, building supply men, statisticians and others vitally interested in this subject were successful in obtaining authorization for a complete census of the construction industry for the year 1929.

The statistics developed by this census were obtained by questionnaires and field agents from contractors, manufacturers, fabricators of construction materials which they themselves used on construction jobs, and from dealers who operated a construction department in conjunction with their regular sales business. The enumeration covered the activities of general contractors, subcontractors and operative builders. Although the law did not make the filing of a report mandatory, if the work performed during the year amounted to less than $25,000, many contractors doing less than this amount of business did file returns and this sample has proved to be of some value in estimating work performed by small contractors.

The compilation does not include work performed by force account and one must, therefore, make allowance for the construction work not performed under contract by the railroads and public utilities in making an estimate of the total volume of construction.

The most serious obstacle to the use of the census data is the fact that they were not published in their entirety until late in 1932, two and one-half years after the period covered had elapsed.

The results of this census were published by states preceding the publication of the *United States Summary*. Each publication contained thirteen tables which are self-explanatory as enumerated below:

Table 1. Value of construction business during 1929, and principle items of expenditure.

Table 2. Construction business of reporting establishments during 1929, by class of ownership and by type of work.

Table 3. Construction business during 1929, by location.

Table 4. Construction business outside home state, by location.

Table 5. Number and salaries of proprietors, firm members, and salaried employees: 1929.

Table 6. Value of construction equipment, in comparison with construction business and wages paid during 1929.

Table 7. Wage earners, by months, and wages paid during 1929.

Table 8. Expenditures of reporting establishments: 1929.

Table 9. Cost of materials furnished and used by reporting establishments during 1929, by kind.

Table 10. Comparison of cost of designated materials furnished and used by reporting establishments during 1929, with cost of materials and value of construction business.

Table 11. Cost of materials furnished and used by reporting establishments during 1929.

Table 12. Number of and volume of business reported by establishments doing a construction business of less than \$25,000 in 1929, percentage of total number of known establishments, and average volume per establishment.

Table 13. Establishments (whose business was less than \$25,000 in 1929) which reported their volume of construction work, classified by range of volume of business.

Such a census is an invaluable aid to the student of the construction industry, but the cost of this census (about \$250,000) makes an annual compilation of similar magnitude prohibitive, even assuming a lower cost for succeeding years.

FEDERAL CONSTRUCTION.—As a background on which to base conclusions on advance planning of the Federal Government's construction activities, the Federal Employment Stabilization Board in 1932 made a complete tabulation of all Federal expenditures for construction since 1920 by fiscal years and by constructing agencies. Table I shows the size of these construction expenditures.

TABLE I

FEDERAL EXPENDITURES FOR NEW CONSTRUCTION, REPAIRS AND ALTERATIONS BY FISCAL YEARS

Fiscal year	New construction, repairs and alterations
1920	\$212,316,000
1921	246,777,000
1922	214,707,000
1923	197,278,000
1924	235,230,000
1925	271,292,000
1926	250,744,000
1927	258,237,000
1928	274,332,000
1929	308,037,000
1930	324,605,000
1931	473,825,000
1932 partly estimated	560,984,000

Compiled by the Federal Employment Stabilization Board

RAILROAD AND PUBLIC UTILITY CONSTRUCTION.—These perform much of their construction and maintenance work by their own employees without awarding a contract and without the necessity of obtaining a building permit. A comprehensive study of the volume of this work was made in 1932 by the Federal Government as an aid to timing construction activities. Table II contains a summary of this study.

TABLE II

ESTIMATED CONSTRUCTION AND MAINTENANCE EXPENDITURES FOR RAILROADS AND PUBLIC UTILITIES

(In millions of dollars)

	1923	1924	1925	1926	1927	1928	1929	1930	1931
Railroads	1,159	1,169	1,223	1,3[illegible]	[illegible]	1,2[illegible]	1,170	1,230	812
Electric Power Co.	822	934	884	[illegible]	814	547	[illegible]	968	651
Telephone Co.	409	491	542	574	[illegible]	613	725	817	601
Electric Railroad Co.	237	251	242	207	[illegible]	194	191	189	155
Sub Total	2,657	2,845	2,851	[illegible]	[illegible]	[illegible]	[illegible]	3,201	2,225
Pipe Line Co.	....	....	....	....	....	....	....	515	409
Gas Co.	....	....	....	....	....	....	....	226	167
Telegraph Co.	....	....	....	....	....	....	....	73	37
Waterworks Co.	....	....	....	....	....	....	....	41	25
Aviation Co.	....	....	....	....	....	....	....	7	6
Cotton Warehouses	....	....	....	....	....	....	....	3	3
Totals	....	....	....	....	....	....	....	4,072	2,932

Compiled by Federal Employment Stabilization Board

This compilation will be continued in the future and it is believed that the information will prove of value in filling in gaps left in the contract-award data.

FINANCING OF CONSTRUCTION

No phase of the construction industry is more obscure than financing. This statement applies with equal force to public and to private building operations. It is highly important to know the sources of money used and to be used in construction, the methods of financing permanent improvements, and the relationships existing between this financing and the money markets. A brief review of the few facts currently available will illustrate the paucity of this type of information.

Sources for Public Construction

Approximately one-half of the construction work performed by states, counties, cities and other political subdivisions is paid for from *general funds*. No adequate study of general fund financing is available although the *Financial Statistics of Cities and States*, published by the Bureau of the Census, throws some light on this subject.

Although general funds are used to supplement bond issues floated for specific permanent improvements by states, counties and cities, general funds are the only source used by the Federal Government in payment for construction work. During this past year many suggestions were made in Congress for the setting up of extraordinary budgets which would be used for public works but the innovation was not put into practice. The Treasury continues to sell Federal securities as

funds become depleted rather than to issue bonds specifically for permanent improvements.

The statement was made above that approximately one-half of the permanent improvements in the states, counties and cities was paid for from general funds. The other half is paid for by the *flotation of bonds* usually issued for a specific project. These bonds, whether for state, county, city or other political subdivision, are referred to as "municipals." Information on municipal bond flotations is available through two main sources—the *Commercial and Financial Chronicle* and the *Bond Buyer*.

Either of these series must be carefully used as an index of construction finance. To illustrate this point both series include New York City flotations in their tabulations. New York City financing methods since 1917 have not been comparable to those in any other large city. The usual method of financing outside New York City is the offering of a long term bond issue, the proceeds of which are used in payment for construction work. New York City, on the other hand, finances its construction activity by the issuance of short term Corporate Stock Notes, which are later funded into long term bonds. These long term bonds are included in both compilations of municipal bond flotations even though the proceeds are used actually to refund short term corporate stock. In the long run the effect is the same but in measuring the month to month variations New York City data must be deducted from either series.

Although *special assessments* are used to pay for many local improvements, no adequate record is available except that contained in the *Financial Statistics of Cities and States*, which is not published until over a year has elapsed following the period covered in the tabulation.

Sources for Private Construction

Financing of construction by the railroads and public utility companies comes from surplus, operating revenues or the flotation of bonds. There is no record available of the construction undertaken by these organizations from surplus. Interstate Commerce Commission's reports (monthly, quarterly and annual) show the expenditures by regions of the Class 1 steam railroads for maintenance of ways and structures and maintenance of equipment separately. The *Commercial and Financial Chronicle* and other financial publications compile information on the flotation of railroad and public utility bonds.

Private construction, such as residences and office buildings, are likewise financed through the borrowing capacity of the individual or firm, as well as through the withdrawal of savings. The borrowings

may be made from or through the building and loan associations, life insurance companies, banks or real estate bond houses.

BUILDING AND LOAN ASSOCIATIONS. Building and Loan Associations are the most important financing agency for urban construction. The annual report of the Secretary of the United States League of Building and Loan Associations becomes available in the summer of each year. These reports show the number of members, total assets of the associations and total amount of mortgage loans outstanding at the end of the year. At the end of 1930 the associations numbered over twelve million members and had approximately eight and three-quarter billions in assets with over eight billion dollars of mortgage loans outstanding. What proportion of these loans are made for new construction and what proportion are made for other purposes is not known for previous years. Within the last year, however, several of the State Leagues have inaugurated a reporting system which now indicates from month to month the total amount loaned broken down into three classifications: loans for new construction; loans made on structures not previously financed; and other loans. The percentage of loans made for new construction varies materially from month to month indicating the impossibility of applying any definite ratio to annual mortgage loans in attempting to estimate the new construction financing of the Building and Loan Associations. For example, the data made available by the New York State Building and Loan Association League during 1932 show a variation of from 22 to 6 per cent between January and June in the percentage of new construction loans to all loans. With the passage of time these statistical reports of the Building and Loan Associations should prove of great value in estimating the current importance of the Building and Loan Associations' financing from month to month.

LIFE INSURANCE COMPANIES.—These are the second most important agency for financing buildings. At the end of 1931 fifty-two of the leading life insurance companies, whose combined assets represented 92 per cent of the total admitted assets of the legal reserve companies of the United States, held six and one-quarter billion dollars in mortgages. This series is available over a long period of years and gives an excellent picture of the trend of such holdings but does not present the facts on the month to month activity of the life insurance companies in the lending of money for new construction. The *Survey of Current Business* now publishes the mortgage loans outstanding each month but this does not give the loans made for new construction.

BANKS.—Financing of construction by the banks is important, but information available on their activities is inadequate. The Comp-

troller of the Currency's Annual Report contains information on banks showing their total real estate loans, mortgages, deeds of trust and other liens on real estate four times each year. No attempt is made, however, to obtain information even from national banks on the loans that they make to finance new construction.

REAL ESTATE BOND HOUSES.— The most comprehensive information on new capital issues is published by the *Commercial and Financial Chronicle* and dates back to 1919. The *Survey of Current Business* now publishes the *Chronicle's* report broken down into the types of buildings for which these long term issues were floated. This breakdown would be of great value if the underlying data were more complete. It appears, however, that the *Chronicle* series is but a sample of the total flotations of long term bonds through investment houses. One reason this series is comparatively small appears to be the fact that many mortgage bonds, the proceeds of which are to be used in the financing of new construction, are not offered publicly nor are they advertised and consequently, do not appear in a tabulation such as the *Chronicle's*.

Cost of Construction Credit

W. C. Clark, in an address before the American Statistical Association in December, 1931, stated that[1]

> Another vital aspect of the real estate market concerning which our data are of very little value is the matter of interest rates, or rather of the cost of urban mortgage credit for interest rates and total cost are by no means the same thing. The market for building finance is a comparatively sluggish one. Interest rates on real estate mortgages change but slowly over a fairly long period of time. Adjustment to changing conditions of supply and demand for building capital is first effected through changes in underwriting discounts and expenses, which may vary over a rather wide range. Compilations of coupon rates on advertised issues therefore would in any case throw but little light on the real cost of mortgage money. Based on our inadequate records of real estate security issues, their defects are still further multiplied. These defects inhere in the series published monthly by the *Survey of Current Business* which shows the average coupons on the *Chronicle's* long term real estate bond issues offered by mortgage bond houses during the month. Moreover, as the real estate bond is so highly variable a commodity, the series is characterized by erratic short term fluctuations due merely to the different proportions in which issues of varying qualities happen to be combined in the monthly periods. Thus the declining tendency of the series of 1930 is an indication not of easing money conditions in the real estate market, but rather of the fact that difficult conditions had driven out of the market all but the most conservative lenders and all but borrowers of the highest quality. A satisfactory series would probably require the rating of issues and the calculation of average coupon rates for security groups or classes, each of approximately uniform quality. Occasional information in regard to the state of the mortgage

[1] *Proceedings of the American Statistical Association*, March, 1932, p. 141.

market and the prevailing range of rates for funds in various districts is published by the National Association of Real Estate Boards. We have also such studies as that of the Institute of Research in Land Economics and Public Utilities which show gross yields earned by the mortgage investments of the leading life insurance companies over a period of years. These yields, however, relate to all loans on the companies' books and are not an indication of current market conditions.

FORECLOSURES AND DEFAULTS.—No adequate data are available on foreclosures or defaults either public or private at the present time.

CONSTRUCTION COSTS

Difficult as the problem of measuring construction costs may be, the necessity is urgent enough to call for an exhaustive study.

Existing data on construction costs are inadequate to measure either the level of changing costs for different types of structures in different geographic locations or to indicate with any degree of certainty specific costs at a definite time.

General Indexes

There are three well known indexes which show the changing costs of general construction on a national scale, the *Engineering News-Record*, the New York Federal Reserve Bank and the *Constructor*.

All three of these indexes contain data on but two elements—labor and material. No index takes into consideration the cost of equipment or equipment rental, interest payments, contract bond premiums, compensation and liability insurance premiums, and other elements going into general overhead expense and profit. According to the Census of Construction the total value of construction business reported in 1929 was distributed as follows: wages 33 per cent; materials 47 per cent; other items 20 per cent. It can be seen by this cross section study that existing construction cost indexes completely disregard those items which total about 20 per cent of the total cost.

ENGINEERING NEWS-RECORD.—This index was started in 1917. After study, it was decided to base the index on four factors: the quoted prices for steel, lumber, cement, and labor. A study of the relative importance of these four factors indicated that they should be weighted as follows:

	Per cent
Steel	38
Lumber	17
Cement	7
Labor	38
	100

To arrive at these weights, quoted prices were taken for 2,500 lbs. of structural steel, f.o.b. Pittsburgh mill in carload lots; M.6. M. b.f. long leaf yellow pine at wholesale, delivered to dealers f.o.b. New York; 6 bbls. of cement f.o.b. Chicago in carload lots exclusive of the cost of bags; and 200 man hours of common labor in 20 cities. Monthly data for each of these four factors were found beginning with 1914 with the average of 1913 used as a base (100). Since that time the index has been carried forward without major revision. As a result of this method of using these four factors, subsequent price movements have shifted the weights and between 1917 and the middle of 1932 the following changes have occurred: steel, from 38 to 20 per cent; lumber, from 17 to 16 per cent; cement, from 7 to 5 per cent; labor, from 38 to 54 per cent.

The *Engineering News-Record's* cost index uses only three construction materials. It is doubtful that three materials are sufficient to give an accurate month to month measurement of building material costs. The fact also that the index is made up of published or quoted prices rather than actual prices being paid on the job makes this part of the index unrealistic in times of stress when contractors are able to buy materials at from 10 to 25 per cent under the quoted price. The argument advanced in favor of the use of these three materials is that they are three of the most important materials used in construction. (Twenty-four per cent of the total value of materials used by contractors in 1929 was represented by these three materials, according to the Census of Construction taken in that year.) Until 1930, the union rates of building labor were used. Since that time the labor factor has been computed by using a simple arithmetic average of the union, non-union and prevailing rates in 20 cities as reported by correspondents of this publication.

FEDERAL RESERVE BANK OF NEW YORK.—The Bank publishes an index which during periods of relative stability covers the cost of building quite accurately. The chief criticism of all cost indexes applies, however, with great force to this index during any period of change, inasmuch as both their material costs and their wage rates are quoted prices rather than prices actually paid. The index of building material prices (given a weight of 55 per cent in composite index) is now obtained from the revised index of the Bureau of Labor Statistics. Wage rates (given a weight of 45 per cent in the composite index) are computed from union wage rates of carpenters, bricklayers and laborers in 17 cities with each type of labor in each city weighted. This index starts in January, 1919.

THE CONSTRUCTOR.—This publication of the Associated General Contractors of America, weights its index with 40 per cent labor

costs and 60 per cent material costs. This weighting is more accurate than that used by the *Engineering News-Record* or the Federal Reserve Bank of New York, according to the facts developed by the Census of Construction. Up to and including April, 1932, *published wage rates* for hod carriers and common labor as published in the *General Building Contractor* were used. Realizing that these data did not represent wages actually paid, the Associated General Contractors asked twelve of their secretaries in widely separated cities to report each month the *actual wages* paid in their areas. This caused an apparent drop of over 15 per cent in this series between February and May, 1932. This index begins with 1913 as the base year.

TURNER INDEX OF BUILDING COSTS. The Turner Construction Company has compiled an annual index of building costs. Officials of the company state

> First—We use union labor rates in the detailed calculations, but make an allowance after calculations have been concluded to cover indeterminable factors of which payment of labor at rates below the union scale is one. Second—we use prices actually paid for materials. Third—productivity of labor and efficiency of plant and management can be measured mathematically by comparing actual unit costs on similar work in different years. The effect of competitive conditions is one of the indeterminable factors. Fourth—our index is not actually computed in detail oftener than once a year.

BASED ON COST PER SQUARE FOOT (DODGE DATA). Theoretically an index based on actual costs of construction should be the most accurate. It could be obtained easily each month by dividing the value of the contracts awarded by types by the square feet as reported for those types. This would give an average cost per square foot each month for all of the classifications used by the Dodge Corporation. Such a cost series would be automatically weighted correctly for the varying ratios between labor, material and other costs, as well as the varying ratios within each factor.

Unfortunately, however, many of the Dodge classifications do not lend themselves to this treatment inasmuch as no square foot data are possible for many types of public utilities, social and recreational projects, and public works. Other classifications such as residences, should lend themselves perfectly to this treatment, but this method does not lead to satisfactory results. Not only are the month to month fluctuations too erratic to lend credence to the method, but the level of square foot costs is not in accordance with what little knowledge we have on the subject. Some classifications, such as educational buildings, commercial buildings, public buildings and factories, appear to have cost more per square foot in June, 1932, than in 1928 and 1929.

The method is unsound because it does not allow for the changing type of construction. For example, in residential work the tendency to shift from speculative building to non-speculative building which has taken place during the past two years would upset such an index. Another reason for the failure of the method is that higher grade materials are now going into buildings, which tends to increase the cost per square foot. The Dodge data contain valuation but not square feet data for alterations and repairs which, at the present time, constitute a large percentage of the contracts awarded for residential types of building. The contract information in many cases includes expensive machinery and equipment for which segregation is not possible, thereby upsetting any calculations made on the basis of average cost per square foot. Calculating square foot cost by using Dodge contract data throws but little light on construction costs.

There appears to be no statistical information available on building costs based on cubic foot costs even though estimates on specific building projects are usually built up on a cubic foot basis.

Building Material Prices

Available indexes on the prices of materials entering into construction are unfortunately based on quoted prices rather than actual prices in almost every case. In addition to the material prices used by the *Engineering News-Record*, the *Constructor* and other construction costs sources, indexes of material prices are compiled by the Bureau of Labor Statistics, *The Annalist*, *Bradstreet's*, and the U. S. Department of Commerce.

BUREAU OF LABOR STATISTICS.—Beginning with January, 1913, the Bureau has compiled an index based on wholesale prices of building materials. This index now comprises monthly quotations for 112 separate materials entering into construction. It is an excellent index for quoted prices, but does not indicate at any time the wide divergence that may exist between quoted and actual prices.

THE ANNALIST.—The *Annalist* weekly index of wholesale commodity prices as at present constituted began with January 1, 1925, and contains a separate composite series on the cost of four building materials: lumber, brick, structural steel and cement. These quoted prices are available each Friday as of the preceding Tuesday and have the great advantage of prompt publication. The index is subject to the same criticism made against that of the *Engineering News-Record*. In the case of the *Annalist* the following weights are given to these four building materials: 28,102 M ft. of lumber, 4,553 M brick, 5,001,700 lbs. of structural steel, 86,141 bbls. cement. In each case the price is a

composite one as reported to the *Annalist*. With each shift in the quoted price for these materials their relative weight in the *Annalist* index changes.

BRADSTREET'S.—Bradstreet's index on the cost of building materials is based on quoted prices for brick, lime, cement, nails, glass, yellow pine, West Virginia spruce, and Douglas fir. The method used in weighting the individual materials consists of reducing these items to a per pound basis and taking a simple average of the sum.

U. S. DEPARTMENT OF COMMERCE, DIVISION OF BUILDING AND HOUSING.—This Division compiles a monthly index on the prices of building materials only weighted to represent the relative cost of constructing a six-room frame house and six-room brick house. These indexes are based on prices paid for materials by contractors in some 60 cities in the United States as reported by representatives of the Department of Commerce. The index numbers are given as of the first day of each month.

SPECIFIC COSTS

A step in the right direction has been made by the American Appraisal Company, the Morton C. Tuttle Company, the Aberthaw Company, and A. S. Richey in compiling indexes representing the construction costs of various types of structures.

THE AMERICAN APPRAISAL COMPANY. This Company compiles four separate indexes in an attempt to measure the cost of: (1) brick, steel and frame structures; (2) brick, wood and frame structures; (3) frame structures; and (4) reinforced concrete structures, based upon material and labor costs prevailing in nine territorial districts of the United States, weighted in accordance with cost percentages determined from buildings of each type actually constructed.

MORTON C. TUTTLE COMPANY.—The monthly index compiled by this Company is based on current prices of labor and materials contained in a building constructed by the Tuttle Company in New England in 1915.

THE ABERTHAW CONSTRUCTION COMPANY.—This index measures the relative changes in the cost of constructing a standard concrete factory building based on the actual cost of a concrete building in Connecticut in 1915. This cost index is brought up to date quarterly. The Aberthaw index declined 12 per cent from 1920 to July, 1932, while the Tuttle index showed a decline of 27 per cent, indicating that the latter gives a picture more in accord with current conditions than do the Aberthaw data.

A. S. RICHEY.—A. S. Richey of the Worcester Polytechnic Institute

compiles a monthly index, available since 1914, representing the construction costs for electric light and power construction. The index is a weighted average of items entering into total construction costs including conductors, electrical and mechanical equipment, labor, structures and several miscellaneous items. This index can be checked only by comparing it with cost studies based on actual experience in the electric light and power field.

RENTS

Important as rental data are in estimating the demand and supply of buildings there is very little material available on this subject. Only two indexes on rents exist—those of the Bureau of Labor Statistics and of the National Industrial Conference Board. Both of these indexes are used by their compilers as important elements in their studies on the cost of living.

THE BUREAU OF LABOR STATISTICS.—The Bureau's figures are based on rental rates of from 400 to 2,200 houses and apartments in 32 cities. The quotations are obtained by questionnaire from real estate agencies, based on the rent, unfurnished, for houses, flats and apartments of four or five rooms of a type which would be occupied by wage-earners and people on small salaries. Since 1924 these surveys have been made twice a year, in June and December. Previous to 1924 they were made at irregular intervals back as far as 1913, the base year.

THE NATIONAL INDUSTRIAL CONFERENCE BOARD.—The Board sends questionnaires each month to real estate boards, chambers of commerce, social agencies and to certain individuals who are in touch with the rental situation of their localities. Each coöperator is asked to state for the 15th of the month "the approximate average monthly rent for a house or apartment of four or five rooms, with bath, heat not furnished by the landlord, such as is usually occupied by wage-earners." At the present time reports are received from 173 cities—63 in the East, 38 in the South, 56 in the Middlewest and 16 in the far West. The average number of cities reporting during the year 1930 was 172 and the average number of reports received was 539. Only four cities with a population of 100,000 or more are not represented in the survey. The cities covered by the study range in population from 25,000 to 100,000. The index is computed by calculating the percentage of change from the previous month. The National Industrial Conference Board states:

> These percentage changes are averaged for each city and an index is determined for each city by linking the average percentage change to the index number of the previous month which is now computed on the base of December, 1928 (100).

The cities are then divided into five groups on the basis of population and an index for each group is found by the arithmetic mean of the indexes of the cities within each group. These group indexes are weighted on the basis of the total population in cities of each class in the United States, the result being the rent index for the United States as a whole on a December, 1928, base.

THE ALBERT WENZLICK REAL ESTATE COMPANY.—The Wenzlick Company has long been active in this field of research in St. Louis and has compiled two indexes of rents for greater St. Louis beginning with 1922. They are: (1) single family dwellings, per room, per month, and (2) apartments, per room, per month. No deduction is made for concessions which at least in the case of apartments have been almost universally allowed during the last few years, generally in the form of a free month on a year's lease. These indexes are compiled intelligently and offer a good example of what can be done in compiling rental indexes for a single locality.

VACANCY AND OCCUPANCY RECORDS

An understanding of the market for residences, apartments, stores, offices, factories and other types of buildings is essential to an understanding of the economics of construction. Such information is of a local character and for that reason it does not lend itself readily to national compilations with the very limited amount of information currently available.

U. S. DEPARTMENT OF COMMERCE, DIVISION OF BUILDING AND HOUSING.—The Division of Building and Housing has long advocated vacancy and occupancy surveys as the best method of obtaining local data on the real estate market. Local real estate boards are vitally interested in this research and have assisted and, in many cases, made surveys of this character. The most comprehensive report available is that compiled by the Division of Building and Housing on August 1, 1932. This report shows that 38 such surveys have been made in the last year. Two essentials to making such local surveys of national value are: (1) a definite and iron-clad classification of types of residences, offices, etc., covered; and (2) comparable dates among cities and if possible periodic surveys so that the trend in the locality may be ascertained.

Thus far such surveys have been limited almost exclusively to dwellings.

THE NATIONAL ASSOCIATION OF BUILDING OWNERS AND MANAGERS.—The Committee on Renting of this Association has conducted three surveys each year since 1924 to obtain information on vacancies in office buildings and new office buildings under construction. This survey

now includes reports from about 40 cities, covering approximately 2,000 office buildings with a total of approximately 175 million square feet of office space. It shows the square feet of vacant space and the percentage of the total that is vacant for each survey. Detailed data are shown by cities on a percentage basis only. Square feet of floor space contained in buildings under construction are shown by cities.

The value of this survey is indicated by this quotation from the survey bulletin of May 1, 1932:

> Percentage of vacancies indicates that for the past year absorption has not kept pace with the space added in new buildings. Also some cities report actual contraction due to present business conditions. Over the past few years the area of unoccupied space has increased greatly on account of the large amount of new building.

MISCELLANEOUS STUDIES.—Two rather complete surveys of individual cities have been made during the last three years. Denver, in 1929, was completely covered in a vacancy survey made by the local real estate board, through the coöperation of the Post Office Department.

Albert Wenzlick and his associates have also made a thorough vacancy survey of St. Louis.

The ground work is now being laid in Cleveland, Ohio, by a representative of the National Conference on Construction, looking toward a complete building survey in this city in the months to come. In Cleveland the project will be financed by banks, the local Real Estate Board, members of the Chamber of Commerce and others. This survey should serve as an excellent experiment on how detailed a study can be made in a city the size of Cleveland and the resulting data should be of great value to those interested in the construction industry.

DIRECT EMPLOYMENT ON CONSTRUCTION

No accurate measurement of the number of men directly employed in building or construction operations is available, although estimates have been made from time to time by numerous people interested in this subject. The fact that these estimates have varied by as much as 100 per cent indicates the lack of basic information on this important problem.

Two statements of the number of men directly employed in construction will illustrate the wide divergence to be found even in official figures. The Census of Occupations in 1930 shows, 2,502,000 "gainfully employed" on construction and under "construction and maintenance of streets, roads, and sewers" an additional 453,000 or a total of over 3,000,000. On the other hand, the Census of Construction

indicates that there were only 1,008,000 directly employed on construction work. It appears reasonable to suppose from the methods and definitions used in compiling the information that these two figures constitute the maximum and minimum. The Census of Occupations probably represents the maximum figure. It is the opinion of Census officials that a great many answered "construction" even though the man on whom they were reporting—or for that matter, the man who reported his own occupation—may have been employed but a short time in this field during slackness in his own line. Thousands of men throughout the country turn to jobs in the building industry during the spring construction season even though they may be employed in other trades throughout the rest of the year. The Census of Construction probably represents too low a figure inasmuch as the questionnaires were answered by contractors doing a business of at least $25,000 in 1929, and did not cover employees working on construction not under contract.

These two cross-section studies are being supplemented at the present time by the Bureau of Labor Statistics' monthly series on employment and payroll in building construction. Work on these series began in 1930, and January, 1931, is the first month for which the sampling data are available. Table III indicates the progress in obtaining the data.

TABLE III

PROGRESS OF "EMPLOYMENT IN THE BUILDING CONSTRUCTION INDUSTRY" DATA

(Now being compiled by Bureau of Labor Statistics)

	Localities	Increase	Establishments	Increase	Employees	Employees per establishment
1931						
January	7	..	1,644		24,127	15
February	7	0	1,699	55	22,860	13
March	6	−1	1,777	78	21,944	11
April	8	2	2,099	322	32,498	15
May	14	6	3,072	973	46,002	15
June	23	9	4,333	1,261	65,170	15
July	28	5	4,984	651	70,415	14
August	30	2	5,058	74	70,449	14
September	33	3	5,926	868	78,132	13
October	33	0	6,243	317	73,774	12
November	46	13	8,214	1,971	81,287	10
December	54	8	8,737	523	88,130	10
1932						
January	63	9	9,321	584	77,670	8
February	70	7	9,295	−26	72,010	8
March	70	0	9,170	−125	62,617	7
April	71	1	9,875	705	85,703	9
May	72	1	10,094	219	79,260	8
June	78	6	10,349	255	81,681	8
July	78	0	10,521	172	87,289	8
August	78	0	10,464	−57	86,170	8
September	81	3	10,408	−56	85,102	8
October	81	0	10,397	−11	85,310	8
November	81	0	10,268	−129	78,070	8
December	..	..	......	....	......	..

Three questions of fact arise in estimating the value of this series statistically: First, are the localities representative? Second, are the reporting establishments representative? Third, will secular bias destroy the value of the data for comparisons other than seasonal? As yet but few reports are being received from the smaller centers of population and the localities are, therefore, not yet representative. Both union and non-union cities are included in this tabulation. Officials of the Bureau of Labor Statistics state that they are getting reports from about 80 per cent of the firms in the cities covered. From a sample testing of establishments, it appears that the data are fairly representative in this respect. This series *will* have a very heavy secular bias because of the heavy mortality among contractors, particularly in times such as these. The importance of this bias can be realized by remembering that the Bureau's index of factory employment had a downward bias of over 12 per cent between 1923 and 1929 when checked by the Census of Manufactures. Cross-section studies such as the Census of Construction in 1929 would be of inestimable help in correcting for any unavoidable downward or upward shift.

Previous to the Bureau of Labor Statistics' inauguration of its employment in construction series, many states had started to compile information relative to the men employed in building operations. Ohio was the first. Monthly data from that state are available beginning with the year 1914. By 1928, five other states had inaugurated such reporting: Wisconsin, Rhode Island, Pennsylvania, Illinois and Massachusetts.

Since January, 1931, the Bureau of Public Roads has compiled each month the number of men employed directly on Federal and state highways by states. These figures also show the number employed on maintenance work by states.

The amount of direct employment given per dollar of expenditure by types of work and by types of awarding agencies is a highly important problem deserving more attention than has been given to it. Three actual figures have been published. First, an expenditure of $5,785 on general construction under contract is equivalent to one employee on the job for one year, according to the Census of Construction data for 1929. Second, an expenditure of $3,826 for public roads will provide employment on the job to one man for one year, according to a statement made by Thomas MacDonald, Director of Public Roads. Third, one man is given one year's direct employment for each $5,000 expended on public buildings erected by the Federal Government, according to a statement issued by the Treasury Department.

INDIRECT EMPLOYMENT IN THE BUILDING INDUSTRY

Although it is impossible to measure accurately the employment involved in the manufacture and transportation of building materials and equipment, it is frequently heard that there are two men employed indirectly for each man employed directly in building. The materials and equipment involved are indicated in Table IV showing the building materials used during 1929, together with their relative importance.

TABLE IV

PERCENTAGE DISTRIBUTION OF EACH DOLLAR SPENT FOR MATERIALS BY ALL CLASSES OF REPORTING ESTABLISHMENTS THROUGHOUT THE UNITED STATES

(Reporting establishments which did a business of over $25,000 during 1929)

All material distributed by kind
Total value, $1,572,000,000

	Per cent		Per cent
Sand, gravel, stone, etc.	10.4	Roofing and sheet metal	3.0
Brick (face, common, etc.)	4.1	Finished flooring, other, etc.	.4
Tile (fireproofing)	.8	Screens, shades, etc.	.1
Tile (facing, etc.)	1.8	Heating and ventilating equip.	8.0
Concrete and cinder block	.7	Plumbing and gas-fitting equip.	8.3
Cut stone, granite, etc.	2.8	Electrical appl. and supplies	6.3
Riprap, rubble, etc.	.3	Elevators, dumb-waiters, etc.	3.3
Cement	8.0	Pipe (drain tile, vit., etc.)	1.3
Lime	.4	Pipe (cast iron, sheet, etc.)	2.1
Plaster, etc.	1.0	Wire cable, guards, etc.	.2
Structural steel	8.1	Bit. pav. materials, tar, etc.	1.0
Reinforcing steel	3.0	Wood piling and timber	.4
Cast iron, misc. exc. pipe	.5	Ready mixed concrete	.2
Metal doors, windows, etc.	1.1	Machinery	1.2
Metal and wire lath, etc.	.4	Freight, hauling, etc. to job	.3
Ornamental metal work	.0	Cast forms, heads, etc.	*
Lumber (rough and finished)	7.4	Chemicals and chem. products	*
Lath, shingles, etc. (wood)	.3	Metal products, n.e.s., etc.	1.2
Millwork	3.0	Mineral products, etc.	.1
Composition board	.5	Sealing materials	*
Waterproofing materials	.2	Textiles and caulking mat.	*
Hardware (rough and finished)	1.2	Miscellaneous	1.1
Paints, varnishes, glass	2.1		100.0

* Less than one-tenth of 1 per cent.
Census of Construction, 1929

In a study of indirect employment by states, the Federal Employment Stabilization Board, through the coöperation of the Bureau of the Census, compiled employment data showing the number of salaried officers, salaried employees and wage earners by states on the payroll of factories manufacturing 27 major building materials, 85 per cent or more of each material being used in building operations.

The Board has also compiled an index of employment in six industries manufacturing construction materials. The materials covered are: brick, tile and terra cotta, cast iron pipe, cement, millwork, steam fittings, and structural steel. The index measures month to month variation in employment covering approximately 40 per cent of those employed in the production of building materials. It is adjusted biennially with the Census of Manufactures to eliminate secular bias.

SCALES FOR MEASURING THE STANDARD OF LIVING

BY EVELYN G. TOUGH AND E. L. KIRKPATRICK

The accumulation of data from studies of farm standards of living calls for the acceptance of a satisfactory unit for comparing the cost of the goods and services consumed annually. The family cannot be regarded adequate for this purpose, since it fails to take account of the fact that sex, number and age of persons composing it make a difference in the needs for food, clothing, rent and other economic goods and services. Some other unit or scale of comparison, with allowance for these differences, as well as for the first or basic costs borne by all families regardless of the number and ages of persons which they contain, would be found exceedingly useful.

Just what scales of measurement are possible for use in such comparison? How have they been developed? And what can be said of their adequacy as means of measuring the standard of living in terms of costs or expenditures?

This article gives attention to three sets of scales which have been used for comparing the cost of family living; the adult male equivalent, the ammain and the cost consumption unit. These are considered briefly from the standpoint of their development and more fully from the standpoint of their applicability and their adequacy as a means of measurement.[1]

ADULT MALE EQUIVALENT

There are a number of adult male equivalent scales all of which have the cost of living per family based against the consuming power of the adult male as unity or one. The exact age against which this "unity" is based varies, as do the relative weights allotted to other persons in the family.

The adult male equivalent scale regarded best suited for this test was developed by Carle C. Zimmerman for comparing the cost of living among farm, village and city families during 1924-26 and the years immediately following.[2] It is based on food computations of L. Emmet Holt as outlined in *Food, Health and Growth*, 1922. In this

[1] The test of comparability or adequacy here used is similar to that described by the writers in *The American Journal of Sociology*, Vol. XXXVII, No. 3 (November 1931), pp. 424-434. That test included only the adult male equivalent and the cost consumption unit for limited numbers of families.

[2] Carle C. Zimmerman, "How Minnesota Farm Family Incomes Are Spent," "Factors Affecting Expenditures of Farm Family Incomes," "Incomes and Expenditures of Minnesota Village and Town Families," and "Incomes and Expenditures of Minnesota Farm and City Families," *University of Minnesota Agricultural Experiment Station, Bulletins* 234, 246, 253, 255.

scale the expenditures per family annually for all goods and services are weighted against the consuming power of the adult male person 19–60 years of age, as unity. The relative weights allotted to other persons in the family by sex and age groups are:

	Weight		*Weight*
Males 19–60	1.0	Child 13, 14 and 15	1.0
Males above 60	0.9	Child 11–12	0.8
Females 19–60	0.8	Child 9–10	0.7
Females above 60	0.7	Child 6, 7 and 8	0.5
Males 16, 17 and 18	1.2	Child 4–5	0.4
Females 16, 17 and 18	0.9	Child 1, 2, and 3	0.3

This scale, as well as most other adult male equivalent scales, may be regarded as an inadequate measure for expenditures for all purposes since it is based on food only. Numerous studies of standards of living show that food absorbs only 25 to 50 per cent of the total cost of living. Obviously the expenditures for other goods and services may vary out of accord with the expenditures for food.

THE AMMAIN

The ammain scale was designed to go beyond the assumption that the expenditures for all goods and services for persons of different sex and ages vary in accord with the expenditure for food for these persons. It was developed by Edgar Sydenstricker and Wilford I. King as a means of classifying families according to incomes.[1] This scale weights the expenditures for all goods and services by persons of different sex and ages against the consuming power of the male, 23 to 26 years of age, at the maximum of consumption. The relative demands, weighted against the cost of all economic goods consumed by the male at this age —taken as unity or 1—vary from .22 at the first year of age up to 1.00 at the 23rd–26th year and down to .74 at the 80th year for males. They vary from .22 at the first year of age up to .79 at the 21st–25th year and down to .62 at the 80th year for females. Thus, the ammain scale with gradations by separate years from 1 to 80 for male and female is a more refined unit of comparison than the adult male equivalent.

The ammain scale of units would be a satisfactory means of comparing the costs of living for different families provided the same relative demands were made by the third or fourth or other member of the family on the separate elements of family living. This is not the case, however, for studies in rural standards of living particularly. These

[1] See "A Method of Classifying Families According to Incomes in Studies of Disease Prevalence," *Reprint 623 U. S. Public Health Service*, Public Health Service, November 26, 1930. Ammain indicates "adult male maintenance."

studies indicate that the supplementary or added costs for clothing for the son or daughter in the late teens are one and one-half times those for either parent while the added costs for food are about eighty per cent as much. Further, the added costs to meet the demands made by the third and other additional member of the family on the other elements of living, as rent, health maintenance, and education, vary with little or no regard to the total cost of living per family.

THE COST CONSUMPTION UNIT

The cost consumption unit scales used in the test were developed by Kirkpatrick in connection with a study of the standards of living among four hundred *farm families of Livingston County, New York*, 1921–22.[1] In this set of scales, as in Zimmerman's adult male equivalent scale, the consuming power of the adult male is taken as the base for weighting the family expenditures. The relative weights allotted differ, however, for each of the principal groups of goods and services as in Table I.

In this set of scales the adult female, the homemaker, is considered as having the same expenditures as the adult male for the different elements of family living, except food and personal goods and services. From actual figures the average cost of clothing was found to be about the same for the operator and homemaker. Probably both share use of the house, furnishings, health maintenance and operation and advancement goods and services about equally.

TABLE I

[Food]

	First person in age and sex group	Each additional person in age and sex group
	Weights	
Male:		
19 and over *	1.0	0.9
15 to 18 inclusive	.8	.7
Female:		
19 and over	.9	.8
15 to 18 inclusive	.7	.6
Male or female:		
12 to 14 inclusive	.6	.5
6 to 11 inclusive	.4	.3
5 or less	.3	.2

[1] E. L. Kirkpatrick, "The Standard of Life in a Typical Section of Diversified Farming," *Cornell University Agricultural Experiment Station Bulletin 423*, and "The Relation of the Ability to Pay to the Standard of Living," *U. S. Department of Agriculture, Bulletin 1382*.

Clothing	Weights
Operator	1.0
Homemaker	1.0
Other persons:	
Over 24 years	1.4
19 to 24 years	1.7
15 to 18 years	1.3
12 to 14 years	1.0
6 to 11 years	.5
1 to 5 years	.4

Rent	Weights
Operator	1.0
Homemaker	1.0
Other persons:	
First male, 15 years of age or over	.2
First female, 15 years of age or over	.2
Second male, 15 years of age or over	.0
Second female, 15 years of age or over	.0
Third male, 15 years of age or over	.2
Third female, 15 years of age or over	.2
And so on	
First boy, 6 to 14 years of age	.1
First girl, 6 to 14 years of age	.1
Second boy, 6 to 14 years of age	.0
Second girl, 6 to 14 years of age	.0
Third boy, 6 to 14 years of age	.1
Third girl, 6 to 14 years of age	.1
And so on	
All under 6 years of age	.0

Furnishings. Household operation, and life and health insurance	Weights
Operator	1.0
Homemaker	1.0
Other persons, regardless of sex or age	
First	.4
Second	.3
Third	.2
Fourth	.1
Fifth, sixth and others	.0

Maintenance of health	Weights
Operator	1.0
Homemaker	1.0
Children:	
Over 24 years	.4
6 to 24 years	.2
Under 6 years	.0

Advancement	Weights
Operator	1.0
Homemaker	1.0
Children, male or female:	
Over 18 years	.5
15 to 18 years	.3
6 to 14 years	.1
Below 6 years	.0

Personal goods	Weights
Operator	1.0
Homemaker	.8
Children:	
Male 19 years and over	1.0
Male 15 to 18 years	.5
Male 6 to 14 years	.4
Female 19 years and over	.6
Female 15 to 18 years	.5
Female 6 to 14 years	.3
Male or female 5 years or less	.2

*The age groups of sons and daughters are considered from the physiological and the sociological standpoints. The age groups observed are the preschool age, 5 years or less; the grade-school age, 6 to 11 years; the grammar-school age, 12 to 14 years; the high-school age, 15 to 18 years; and the college and "choice of occupation" age, 19 years or over.

COMPARISON TEST OF THE THREE SCALES

In connection with a recent study of standards of living among nine hundred farm families of selected localities in Wisconsin it was found desirable to ascertain which of the three sets of scales was the more satisfactory means of comparison.[1] From the standpoint of labor involved in the calculations, the adult equivalent and the ammain were the most feasible. From the standpoint of the qualitative analysis, however, the cost consumption unit seemed to be the more desirable.

[1] See Stencil Bulletins 104, 105, 106 and 108, University of Wisconsin College of Agriculture, Extension Service 1930 and 1931, for tentative results of this study.

But would the results obtained by the use of the three methods be widely different? If so, which would prove to be the most nearly adequate means of comparison? Would the resultant figures obtained by the use of any one of them be more satisfactory than cost of living per family as a basis of comparison?

As a partial answer to these questions it was decided to test the three methods. The tests were applied to the 880 summaries obtained from the farmer's standard of living study in Wisconsin: that is, the three scales were applied to the same summaries or records. Pearsonian coefficients of correlation constituted the method of comparison.

The application of the adult male equivalent scale to a particular family consisting of husband, wife and five children of different ages and with expenditures amounting to $1,761, is illustrated in Table II.

TABLE II

APPLICATION OF ADULT MALE EQUIVALENT SCALE

Individuals in family		Age of individuals	Relative weight
Males:	Husband	43	1.0
	Son	20	1.0
	Son	4	.4
Females:	Wife	41	.8
	Daughter	17	.9
	Daughter	13	1.0
	Daughter	10	.7
Total		..	5.8

The figure obtained by this method, 5.8, divided into the total cost of living, $1,761, gives an expenditure of $303.60 per adult male equivalent.

The application of the ammain scale to the family with the $1,761 cost of living is similar to the application of the adult male equivalent except for the weights allotted to the different individuals, as indicated in Table III.

TABLE III

APPLICATION OF AMMAIN SCALE

Individuals in family		Age of individuals	Relative weight
Males:	Husband	43	.92
	Son	20	.98
	Son	4	.34
Females:	Wife	41	.73
	Daughter	17	.74
	Daughter	13	.55
	Daughter	10	.45
Total		..	4.70

The figure obtained by the ammain method, 4.7, divided into the total cost of living, $1,761, gives an expenditure of $374.70 per ammain for the family.

The application of the cost consumption unit scales to the same family is as in Table IV.

TABLE IV

APPLICATION OF COST CONSUMPTION UNIT SCALES

Individuals in family		Age (Years)	Food	Clothing	Rent	Furnishings
			Relative weights			
Males:	Husband	43	1.0	1.0	1.0	1.0
	Son	20	.9	1.7	.2	.4
	Son	4	.3	.4	.0	.3
Females:	Wife	43	.9	1.0	1.0	1.0
	Daughter	17	.7	1.3	.1	.2
	Daughter	10	.4	.6	.0	.0
	Daughter	13	.6	1.0	.0	.1
Total or household size index		..	4.8	7.0	2.5	3.0

Individuals in family		Age (Years)	Operation	Health maintenance	Advancement	Personal	Insurance
			Relative weights				
Males:	Husband	43	1.0	1.0	1.0	1.0	1.0
	Son	20	.4	.2	.5	1.0	.4
	Son	4	.3	.6	.0	.2	.3
Female:	Wife	43	1.0	1.0	1.0	.6	1.0
	Daughter	17	.2	.2	.3	.5	.2
	Daughter	10	.0	.2	.1	.3	.0
	Daughter	13	.1	.2	.1	.3	.1
Total or household size index		..	3.0	3.4	3.0	3.9	3.0

When the household size index figure was divided into the total expenditure for each group of goods and services, the expenditures per cost consumption unit were obtained as in Table V.

TABLE V

EXPENDITURES PER FAMILY AND PER COST CONSUMPTION UNIT

Family living	Expenditure per family	Household size index	Expenditures per cost consumption unit
Food	$510	4.8	$108.15
Clothing	263	7.0	37.53
Rent	500	2.5	200.00
Furnishings	8	3.0	2.67
Operation	160	3.0	53.33
Health maintenance	14	3.4	4.12
Advancement	162	3.0	54.07
Personal	35	3.9	8.97
Insurance, life and health	100	3.0	33.33
Total for family	$1,761	...	$502.17

The sum of expenditures obtained by the cost consumption unit method as illustrated above amounts to \$502.17, compared to \$363.60 obtained by the adult male equivalent method and \$374.70 obtained by the ammain method. The difference among the three figures is wider for this particular family than for most of the families. There was practically no difference in the three figures for some of the families.

In order to increase the comprehensibility of the test it is interesting to note the range of expenditures by the three methods. The lowest adult male equivalent figure, for the 900 families was \$92.98, the lowest ammain figure was \$107.48, and the lowest cost consumption unit figure was \$136.42. The highest corresponding figures were \$1,822.06, \$1,957.59 and \$1,880.27. The mean adult male equivalent, ammain and cost consumption unit figures for the 900 families were \$406.02, \$471.16 and \$489.03. The corresponding medians were \$380.25, \$432.00 and \$458.70.

The first step in the comparison was the ascertainment of the Pearsonian coefficients of correlation for expenditures per adult male equivalent, expenditures per ammain, and the sum of expenditures per cost-consumption unit, each in relation to another. The coefficient of correlation for the expenditures per adult male equivalent and the expenditure per ammain is .9431 ± .0025; that for expenditure per adult male equivalent and the sum of expenditures per cost consumption unit is .8560 ± .006; and, that for expenditure per ammain and the sum of expenditures per cost consumption unit is .8567 ± .0002.

The high correlation between the expenditures as ascertained by each two scales suggested that one is about as satisfactory as another as a means of comparison. This suggestion, however, could not be accepted as a final test. Another step was sought in the comparison, and attention was turned to the computation of Pearsonian coefficients for total cost of living per family and expenditure per adult male equivalent, total cost of living per family and expenditure per ammain, and total cost of living per family and the sum of expenditures per cost consumption unit. The coefficients in the three instances are .4825 ±.0173, .5015 ±.0079 and .7729 ± .009.

Results from this step in the comparison suggested a similarity between the adult male equivalent and the ammain as methods of comparison. They indicated discrepancies between expenditure per adult male equivalent and the sum of expenditures per cost consumption unit, and expenditure per ammain and the sum of expenditure per cost consumption unit. On this account it was considered advisable to take the comparison a step further. An additional factor, net cash income per family, was chosen for a dependent variable, against which

to correlate expenditure per adult male equivalent, expenditure per ammain and the sum of expenditures per cost consumption unit, as well as the total cost of living per family. The coefficients of correlation for expenditure per adult male equivalent, expenditure per ammain, the sum of expenditures per cost consumption unit and total cost of living per family, with net cash income as the dependent variable are, $.2361 \pm .0212$, $.2514 \pm .0007$, $.3397 \pm .0190$ and $.3853 \pm .0192$.[1]

Owing to the similarity in results obtained by the adult male equivalent and the ammain scale further analyses were limited to the former in comparison with the cost consumption unit. The results obtained by these two methods were correlated separately with participation in local organization, attendance at church services, and extent of reading and radio auditing at home.[2]

Although the associations were not striking in any of the three instances, they were slightly more significant on the cost consumption unit basis than on the adult male equivalent basis.

Simple correlations between expenditure per adult male equivalent, expenditure per ammain, and the sum of expenditures per cost consumption unit indicate the three to be closely related. When each is correlated separately with total cost of living and net cash family income as dependent variables, the three scales appear to be less consistent. The correlations are higher for the cost consumption unit than for the adult male equivalent or the ammain. This alone, however, does not determine which of the three measures is the most satisfactory.

When the correlations are viewed in the light of qualitative judgments, the cost consumption unit method appears to be the most favorable. The greater exactness with this method gives a feeling of certainty, not given by either of the others. The more detailed attempt to account for the variations according to the different principal groups of goods and services adds to this feeling that the cost consumption unit is the most exact measure. As to the simplicity of the scales, however, the adult male equivalent and the ammain are the more readily applied. The adult male equivalent is even more readily applied than the ammain.

The three units of comparison have their separate fields. The adult

[1] Net cash income per family represents the difference between gross cash receipts from farming and all other sources and cash farm and other expenses, not including family living expenses for the year of study. It is the amount left for family living, for savings, or for re-investment in the farm business resources.

[2] Results of these analyses are available from an unpublished thesis "Development and Applicability of the Cost Consumption Unit and Adult Male Equivalent Scale to the Cost of Family Living," by Evelyn G. Tough, University of Wisconsin.

male equivalent and the ammain are similar, however, in their construc'ion, application, and adequacy. If either one of them is adopted for a particular study, results are likely to be the same.

Generally, the investigator should be familiar with the characteristics of the various units of comparison before making a final decision as to which to use. If it is a question of the use of the adult male equivalent or the ammain in preference to the cost consumption unit, the degree of exactness desired in the study may well govern the choice.

THE STANDARD ERROR OF THE COEFFICIENT OF ELASTICITY OF DEMAND[1]

By Henry Schultz, *University of Chicago*

Let the demand function be

$$x = x(y, z, w, \ldots t), \tag{1}$$

where x stands for quantity, y for price, z, w, . . . for other variables, and t for time. The partial elasticity of demand is then

$$\eta = \frac{\partial x}{\partial y} \frac{y}{x}. \tag{2}$$

It is required to determine the standard error of η, given the standard errors of the parameters of (1).

It will be sufficient for present purposes to consider two special cases of demand functions: (1) that in which η is the same at every point on the curve, and (2) that in which η varies from point to point on the curve.

As an example of the first case we may cite the equation

$$x = Ay^{\alpha} e^{\beta t + \gamma t^2}, \tag{3.1}$$

which becomes, upon taking logarithms,

$$\log_e x = \log_e A + \alpha \log_e y + \beta t + \gamma t^2. \tag{3.2}$$

Here the elasticity of demand is a constant:

$$\eta = \frac{\partial x}{\partial y} \frac{y}{x} = \frac{\partial \log x}{\partial \log y} = \alpha. \tag{4}$$

If the demand equation (3.2) is fitted by the method of least squares, the process of fitting may be easily modified so that it will also yield the standard errors of all the parameters.[2] Then by (4)

$$\sigma_\eta = \sigma_\alpha.$$

The only difficulty that may arise in this connection is that when we fit (3.2) we are minimizing the sum of the squares of the logarithmic

[1] In the preparation of this paper, I have had the benefit of discussions with my friend and colleague, Professor Walter Bartky of the Department of Astronomy. The proof of (10.2) is his, and is somewhat neater than the one which I had developed. Professor Bartky also deduced another upper limit for σ_η, but as that limit gave consistently higher values than (10.2), it was considered less satisfactory than the latter.

[2] See my "Standard Error of a Forecast from a Curve," this Journal, June, 1930.

residuals of x, while we may really wish to minimize the sum of the squares of the residuals of x. The former procedure gives greater weight to the low values of x. But this can be overcome by properly weighting the observation equations of (3.2). In any event, the use of the second method of fitting is not likely materially to affect the value of a or its standard error when the data used are annual consumption and average annual prices, for the reason that the scatter of quantity on price (both variables being corrected for secular trend) is generally too small to enable us to say that the two values of a obtained by the two different methods of fitting are significantly different from each other.

As an example of the second case, we may take the equation

$$x = a + by + ct + dt^2. \tag{5}$$

The fitting of this equation by the method of least squares yields the standard error of b, as well as the standard errors of the other parameters. But the elasticity of demand, η, derived from this equation, namely,

$$\eta = \frac{\partial x}{\partial y}\cdot\frac{y}{x} = b\frac{y}{x}, \tag{6.1}$$

is a function of y and x, as well as of b. We are required to determine the error of this function.

Denote the foregoing expression by

$$\eta = \eta(b, y, x). \tag{6.2}$$

Then we know that errors Δb, Δy, and Δx in b, y and x, respectively, are related to a corresponding error $\Delta\eta$ in the function, by the equation

$$\Delta\eta = \eta_b\Delta b + \eta_y\Delta y + \eta_x\Delta x, \tag{7}$$

where

$$\eta_b = \frac{\partial\eta}{\partial b},\ \eta_y = \frac{\partial\eta}{\partial y},\ \eta_x = \frac{\partial\eta}{\partial x}. \tag{8}$$

This expression for $\Delta\eta$ holds for any kind of errors whatever. Thus, if Δb, Δy, and Δx were actual errors of measurement, with known signs, the magnitude and the sign of $\Delta\eta$ could be determined by (7).

In most statistical investigations, however, we are concerned with the *sampling* errors of the several variables, which are given approximately by the standard errors σ_η, σ_b, σ_y and σ_x.

If the correlations between b, y, and x were known, the value of σ_η would be given by the well-known relation

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In most statistical investigations, however, we are concerned with the *sampling* errors of the several variables, which are given approximately by the standard errors σ_η, σ_b, σ_y and σ_x.

If the correlations between b, y, and x were known, the value of σ_η would be given by the well-known relation

(9) $\sigma_\eta = \sqrt{\eta^2_b\sigma^2_b + \eta^2_y\sigma^2_y + \eta^2_x\sigma^2_x + 2r_{by}\eta_b\eta_y\sigma_b\sigma_y + 2r_{bx}\eta_b\eta_x\sigma_b\sigma_x + 2r_{xy}\eta_x\eta_y\sigma_x\sigma_y}$

where the r's are the coefficients of correlation between the variables indicated by the subscripts. But since they are not known, and since it is generally not safe to neglect them, it is desirable to determine an upper limit to σ_η, so that we may have at least some estimate of the sampling fluctuations of η. A simple expression for an upper limit may be obtained from (9) by treating all the partial derivatives as positive and replacing each correlation coefficient by unity. Since the r_{by}, r_{bx}, and r_{xy} are actually less than unity, we have

(10.1) $$\left\{\begin{array}{l} \sigma^2_\eta < \eta^2_b\sigma^2_b + \eta^2_y\sigma^2_y + \eta^2_x\sigma^2_x + 2|\eta_b\eta_y\sigma_b\sigma_y| + 2|\eta_b\eta_x\sigma_b\sigma_x| + 2|\eta_x\eta_y\sigma_x\sigma_y| \\ \quad < (|\eta_b\sigma_b| + |\eta_y\sigma_y| + |\eta_x\sigma_x|)^2 \end{array}\right.$$

or

(10.2) $\sigma_\eta < |\eta_b\sigma_b| + |\eta_y\sigma_y| + |\eta_x\sigma_x|$.

To apply this equation we need the values of the partial derivatives and of the standard errors of b, y, and x.

The partial derivatives are obtained from (6.1), which gives

(11) $$\eta_b = \frac{y}{x},\ \eta_y = \frac{b}{x},\ \eta_x = \frac{-by}{x^2}.$$

The standard error σ_b offers no difficulty, since it is determined in the curve-fitting process. There remains the determination of σ_y and σ_x.

The determination of σ_y gives rise to an interesting question. Since in fitting such a demand curve as (5) we generally minimize the sum of the squares of the residuals in x,

$$\sum_1^n v^2 = \sum_1^n \left\{x_0 - (a + by + ct + dt^2)\right\}^2,$$

we thereby assume that the independent variables y and t are free from errors. Shall we, therefore, put $\sigma_y = 0$ in (10.1)? There could be no objection to this procedure if y were actually free from errors. But this is not true in general. The primary reason for making this assumption is that the assumption that both x and y are subject to error would either make it impossible to fit the demand curve (5) by the method of least squares, or would enormously complicate the process. It is clear, therefore, that under these conditions, to put $\sigma_y = 0$ is to underestimate σ_η. But this is not so objectionable as it appears, since the standard error of the constant-elasticity $\eta = \alpha$ deduced from (3.2) is also subject to the same limitation, for in fitting (3.2), the assumption is made that log y is free from error; the two standard errors would, therefore, be comparable to this extent.

We may, however, make some allowance for the standard errors in y, if we agree to compute our elasticity of demand for that point on the demand curve for which y has its mean value $y = M_y$.[1] Now the standard error of M_y has the well-known value

$$\sigma_{M_y} = \frac{\sigma'_y}{\sqrt{n-1}}, \tag{12}$$

where n is the number of observations, and σ'_y is the *standard deviation* of y, and is to be distinguished from σ_y, which, in this paper, is used to denote the *standard error of sampling* of a particular value of y. This assumption permits us to write

$$\sigma_y = \sigma_{M_y} \tag{13}$$

in (10.2).

For σ_x we may take either the quadratic mean error

$$\epsilon_x = \sqrt{\frac{[vv]_x}{n-m}}, \tag{14}$$

where n = number of sets of observations, and m = number of parameters in the demand equation; or the standard error of the function σ_f

$$\sigma_f = \epsilon_x \sqrt{\frac{1}{w_f}}, \tag{15}$$

where w_f is the weight of the function. These concepts are defined in my "Standard Error of a Forecast from a Curve."[2] The first is an approximation to the hypothetical "standard error of a single observation" of least-square theory, which is assumed to be typical of the entire set of observations, in so far as precision is concerned. The second concept is, it will be observed, not independent of the first, although it is not constant for different values of x.

In computing σ_η, however, it is best to use only

$$\sigma_x = \epsilon_x, \tag{16}$$

primarily because ϵ_x is much easier to compute than σ_f, and secondarily because the use of the latter in this connection gives rise to a logical difficulty.

Making the substitutions (11), (13), and (16), in equation (10.2), and using the least-square value for σ_b, we obtain for the upper limit of σ_η

$$\sigma_\eta < \left|\frac{y}{x}\sigma_b\right| + \left|\frac{b}{x}\sigma_{M_y}\right| + \left|\frac{by}{x^2}\epsilon_x\right|. \tag{17}$$

[1] Even if the elasticity is desired for any other point on the demand curve, it may still be worth while arbitrarily to assume that the (unknown) standard error of y is approximately given by the standard error of the mean of y.

[2] See note 2, p. 64.

As an illustration, we may compute by (17) the upper limit to the standard error of the elasticity of demand for sugar.

Using the adjusted data for 1890–1914, I have shown[1] that the demand for sugar is described excellently either by

$$x = 141.4\, y^{-(0.43016 \pm 0.06828)}\, e^{\text{[illegible]}\, t} \tag{18}$$

or by

$$x = 100.7 - (5.834 \pm 0.805)y + (0.6760 \pm 0.0772)t, \tag{19}$$

where x is the per capita consumption in pounds, y is the real (deflated) price in cents per pound, and t is time in years, the origins of x and y being at 0, 0, and the origin of t being at 1902. The figures preceded by $\pm$ are least-square standard errors instead of probable errors as given in the reference.

From (18) the elasticity of demand with its standard error is easily seen to be the exponent of y, for

$$\eta = \frac{\partial x}{\partial y} \cdot \frac{y}{x} = \frac{\partial \log x}{\partial \log y} = -0.43016 \tag{20}$$

and

$$\sigma_\eta = \pm 0.06828. \tag{21}$$

This value of η is, of course, a constant, independent of y, x, and t.

From (19), the elasticity of demand is

$$\eta = \frac{\partial x}{\partial y} \frac{y}{x} = -5.834 \frac{y}{x}, \tag{22.1}$$

which is an explicit function of y and x, and an implicit function of t. To determine its numerical value we must fix y and x; and to determine x, we must fix t, as well as y.

If we fix y and t by giving them their mean values $y = M_y = 5.057$, and $t = M_t = 0$ (since the origin was taken at 1902), we derive the value $x = 71.224$.[2] Substituting these values of y and x in (22.1), we have

$$\eta = -5.834 \frac{5.057}{71.224} = -0.414. \tag{22.2}$$

To obtain the standard error of this value, we must know the values

[1] *Der Sinn der statistischen Nachfragekurven*, Heft 10, Veröffentlichungen der Frankfurter Gesellschaft für Konjunkturforschung, edited by Dr. Eugen Altschul, Bonn, 1930, pp. 64–71, especially note 23.

[2] This happens also to be the arithmetic mean of x, because (19) is a straight plane, and we know that a straight plane, fitted by the method of least squares, must pass through the center of gravity of the observations. If the demand function (19) had not been linear, then the value of x obtained by giving the independent variables y and t their mean values would not have been equal to its mean value.

of the terms on the right-hand side of (17). The least-square procedure which was used in fitting (19) yields, or can be made to yield,

$$|\sigma_b| = 0.805, |\sigma_{M_v}| = 0.141, \text{ and } |\epsilon_z| = 1.846.$$

The values of y and x used in (22.2) also yield

$$\left|\frac{y}{x}\right| = 0.0710, \left|\frac{b}{x}\right| = 0.0819, \text{ and } \left|\frac{by}{x^2}\right| = 0.00582.$$

Substituting these values in (17), we obtain for the three terms

$$\left|\frac{y}{x}\sigma_b\right| = 0.0571, \left|\frac{b}{x}\sigma_{M_v}\right| = 0.0116, \text{ and } \left|\frac{by}{x^2}\epsilon_z\right| = 0.0107.$$

Their sum, 0.0794, is an upper limit of σ_η, or $\sigma_\eta < 0.0794$. This may be compared with the standard error derived from (18), namely $\sigma_\eta = \pm 0.0683$.

Generally the middle term adds little to the value of σ_η. Several random comparisons indicate that its inclusion rarely increases the standard error by as much as 30 per cent.

In a study [1] in which I have had occasion to apply formula (17)—or, rather, the more general formula (10.2)—to many different demand functions, I have found that it gives results which are fairly consistent with those derived by other methods.

[1] "A Comparison of the Elasticities of Demand for Selected Commodities Obtained by Different Methods," read before a joint meeting of the Econometric Society with the American Statistical Association, *Washington, D. C., December 29, 1931*; to that published in *Econometrica*.

THE STANDARD DEVIATION AS A MEASURE OF THE INTENSITY OF SEASONAL ADJUSTMENT

By R. von Huhn

To free a series of observations from its seasonal amplitude, various methods are being used at present. The seasonal factor having been determined and adjustments computed, seasonal undulations disappear and the adjusted observations show the smoothing influence of the conversion. Table I shows 264 observations of an economic phenomenon for the period 1910–31. These data show a strong seasonal movement. The periods 1910–16 and 1922–28, respectively, were selected as base periods for the index of seasonal variation.[1] Columns A and B show the unadjusted and adjusted units for the respective periods.

Table II shows a frequency distribution of the unadjusted and adjusted units for the periods 1910–31, 1910–16 and 1922–28. In the case of the first and second period, the seasonal factor based on the period 1910–16 was used for the adjusted units, whereas the period 1922–28 was first adjusted by the seasonal index having 1910–16 as a base and then by the seasonal index having 1922–28 as a base period. In each case the significant statistical measures of variation were computed, namely, the standard deviation and the coefficient of variation. The frequency distribution of unadjusted and adjusted units for the period 1910–31 (264 observations) shows that the actual units are distributed over a range of 20 class intervals, as compared with 14 class intervals after adjustment for seasonal variation. The movement of concentration of the adjusted values toward the class interval containing the arithmetic mean (29.27 units) takes place from the lower unit groups upward and from the higher unit groups downward. Chart I shows the distribution of unadjusted and adjusted units for 1910–31, after absolute frequencies have been reduced to a per cent basis. Comparison between the two frequency curves "unadjusted" and "adjusted" shows the marked concentration in case of the latter, the standard deviation for the unadjusted units being $\sigma_u = 10.72$ units as compared with $\sigma_a = 7.80$ units for the adjusted series, and the coefficient of variation being $V_u = 36.01$ and $V_a = 26.04$, respectively.

When computing the difference between the standard deviation of the unadjusted units and the adjusted units of the same period it appears that the larger this difference, by so much is the adjustment more

[1] The seasonal factors were computed by the method outlined by Wagemann. See: Dr. Ernest Wagemann, *Konjunkturlehre*, Berlin, 1928 (Verlag Reimar Hobbing, pp. 233–235).

TABLE I

Column: (A) Unadjusted; (B) Adjusted

Year	January A	January B	February A	February B	March A	March B	April A	April B	May A	May B	June A	June B	July A	July B	August A	August B	September A	September B	October A	October B	November A	November B	December A	December B
1910......	29.7	22.9	25.9	23.9	20.8	24.3	18.6	24.4	18.4	24.1	18.2	23.7	17.9	23.1	18.5	22.2	20.9	21.5	23.8	21.2	27.2	20.5	29.7	20.7
1911......	26.2	20.2	19.3	17.8	15.7	18.3	14.8	19.4	14.6	19.2	14.4	18.8	14.8	19.1	16.4	19.6	18.7	19.3	21.8	19.3	26.1	19.7	29.1	20.3
1912......	29.3	22.6	26.8	24.7	21.2	24.7	17.4	22.8	16.0	22.2	16.7	21.8	17.0	21.9	18.2	21.8	20.6	21.2	24.0	21.2	27.8	21.0	28.2	19.7
1913......	24.8	19.1	21.1	19.5	17.9	20.0	15.9	20.0	16.1	21.2	16.5	21.9	16.4	21.1	17.7	21.2	21.3	21.9	26.0	23.0	31.3	23.6	32.9	22.0
1914......	29.8	23.0	25.3	23.3	22.2	25.9	16.4	21.3	16.9	22.2	17.2	22.4	17.5	22.6	19.1	22.9	22.5	23.2	23.7	21.0	29.2	21.3	31.9	22.2
1915......	31.7	24.4	23.7	21.9	16.5	19.3	16.6	21.8	16.5	21.7	16.1	21.0	16.3	21.0	17.3	20.7	20.6	21.2	24.0	21.8	29.4	22.2	31.1	21.7
1916......	28.8	22.2	24.2	22.3	18.2	21.2	17.7	23.2	18.5	24.3	18.9	24.6	19.9	25.6	21.6	25.9	25.3	26.1	30.4	26.9	34.9	26.3	38.3	26.7
1917......	38.1	29.4	35.7	32.9	25.3	29.5	28.5	37.4	30.2	39.6	29.9	30.0	29.0	37.4	30.5	36.5	35.8	36.9	38.5	34.1	41.2	31.1	45.9	32.0
1918......	48.9	37.7	45.8	42.3	30.9	36.1	30.4	39.9	30.6	40.2	29.5	38.5	33.0	42.5	35.2	42.2	39.1	40.3	44.9	39.7	51.7	39.0	59.3	41.4
1919......	55.3	42.6	34.8	32.1	33.9	39.6	36.0	47.2	38.9	51.0	36.1	47.1	37.9	48.8	40.6	48.6	43.1	44.4	51.0	45.1	59.1	44.6	69.6	48.5
1920......	60.9	47.0	48.5	44.7	40.5	47.3	36.6	48.0	37.5	49.2	35.9	46.8	37.8	48.7	42.5	50.9	48.6	50.1	54.6	48.3	62.9	47.5	67.1	46.8
1921......	54.5	42.0	31.0	28.6	26.8	31.3	20.5	26.9	19.4	25.5	20.1	26.2	24.3	31.3	28.9	34.6	30.9	31.8	39.4	34.9	50.0	37.7	51.1	35.6
1922......	31.7	24.4	31.4	29.0	19.5	22.8	20.0	26.2	20.9	27.4	20.2	26.3	20.3	26.2	20.6	24.7	27.3	28.1	34.6	30.8	43.6	32.9	47.2	32.9
1923......	37.8	29.1	29.9	27.6	25.4	29.6	21.6	28.3	21.5	28.6	20.9	27.2	21.3	27.4	23.6	28.3	29.8	30.7	34.6	30.6	45.6	34.4	45.5	31.7
1924......	35.4	27.3	33.6	31.0	20.4	23.8	19.1	25.1	19.8	26.0	21.1	27.5	22.8	29.4	26.1	31.3	31.8	32.7	38.2	33.8	45.8	34.6	49.0	34.8
1925......	45.6	37.3	35.7	32.9	23.9	27.9	24.2	31.8	24.8	32.3	26.1	34.0	27.9	36.0	30.0	35.9	31.1	32.0	37.7	33.4	46.8	35.3	48.1	33.5
1926......	36.3	28.0	28.9	35.9	24.1	28.1	24.5	32.5	25.2	33.1	25.7	33.5	25.7	33.1	26.4	31.6	31.5	32.4	36.8	32.6	44.0	33.9	47.6	33.2
1927......	36.9	28.5	29.0	26.8	20.8	24.3	20.3	26.6	19.8	26.0	17.8	23.2	20.7	26.7	23.4	28.0	29.4	30.3	35.6	31.5	41.6	31.4	43.3	30.2
1928......	38.2	29.5	29.1	26.8	23.4	27.0	22.8	29.9	24.2	31.8	23.9	31.2	25.6	33.0	27.4	32.5	31.4	32.3	34.9	30.9	39.6	29.9	42.9	29.9
1929......	33.0	25.4	31.9	29.4	28.0	32.7	23.0	30.2	24.4	32.0	26.1	34.0	27.2	35.1	29.8	35.7	33.9	34.9	38.4	34.0	44.2	33.4	45.8	31.9
1930......	38.4	29.6	31.8	29.3	21.3	24.9	21.5	28.2	20.0	26.2	18.6	24.3	18.8	24.2	20.6	24.7	25.3	26.1	26.5	23.5	31.7	23.9	26.8	19.7
1931......	22.1	17.0	14.1	13.0	17.0	19.5	16.2	21.3	13.3	17.5	14.1	18.4	14.8	19.1	17.3	20.7	19.1	19.7	22.7	20.1	26.4	19.9	25.6	17.9

NOTE: Column B: Based on Seasonal 1910–1916.

Year	January A	January B	February A	February B	March A	March B	April A	April B	May A	May B	June A	June B	July A	July B	August A	August B	September A	September B	October A	October B	November A	November B	December A	December B
1922......	....	25.4	....	30.5	....	26.2	....	27.7	....	28.2	....	27.6	....	28.2	....	24.6	....	27.3	....	29.1	....	30.0	....	30.9
1923......	....	33.2	....	29.1	....	34.1	....	30.0	....	29.5	....	28.5	....	27.4	....	28.2	....	29.8	....	29.1	....	31.4	....	29.8
1924......	....	25.3	....	32.7	....	27.4	....	26.5	....	26.8	....	28.8	....	29.4	....	31.1	....	31.8	....	32.1	....	31.6	....	32.6
1925......	....	35.3	....	34.7	....	32.1	....	33.6	....	27.5	....	35.6	....	36.0	....	35.8	....	31.1	....	31.7	....	32.3	....	31.5
1926......	....	29.6	....	25.1	....	32.4	....	34.4	....	34.1	....	35.1	....	33.1	....	31.5	....	31.5	....	30.9	....	30.9	....	31.1
1927......	....	29.5	....	28.2	....	28.0	....	28.2	....	26.5	....	24.3	....	26.7	....	27.0	....	29.4	....	29.9	....	28.7	....	28.3
1928......	....	30.6	....	28.3	....	31.5	....	31.6	....	32.7	....	32.6	....	33.0	....	32.7	....	31.4	....	29.3	....	27.3	....	28.1

NOTE: Column B: Based on Seasonal 1922–1928.

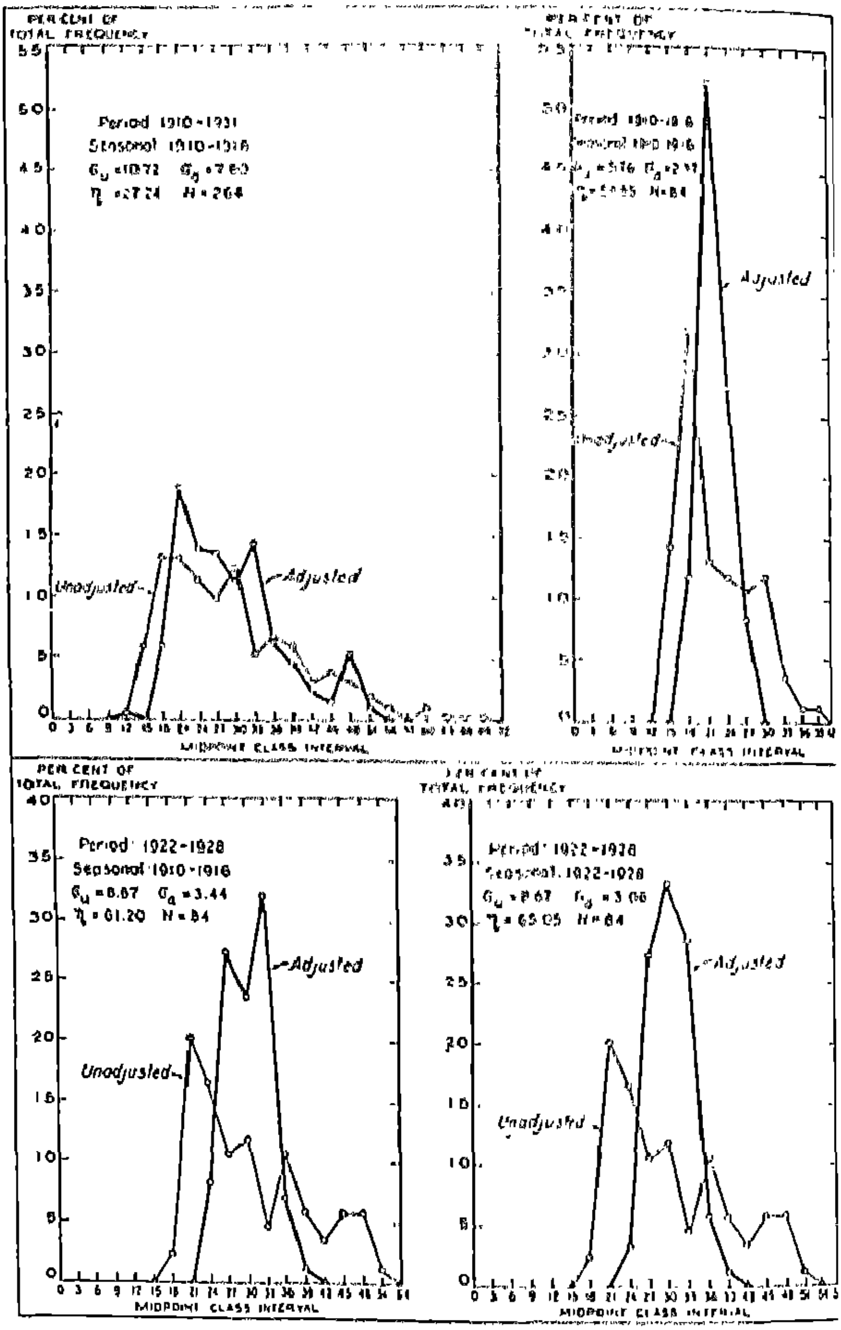

PER CENT OF TOTAL FREQUENCY
Period 1910-1931
Seasonal 1910-1916
Unadjusted
Adjusted
MIDPOINT CLASS INTERVAL
Adjusted
Unadjusted
Period 1922-1928
Seasonal 1910-1916
σ_u = 8.67 σ_a = 3.44
N = 84
Period 1922-1928
Seasonal 1922-1928
N = 84

TABLE II

Class interval in units	Midpoint	1910-31, $N=264$, Unadjusted, Frequency, Absolute	Percentage	Seasonal 1910-16, Adjusted, Absolute	Percentage	1910-16, $N=84$, Unadjusted, Frequency, Absolute	Percentage	Seasonal 1910-16, Adjusted, Absolute	Percentage	1922-28, $N=84$, Unadjusted, Frequency, Absolute	Percentage	Seasonal 1910-16, Adjusted, Absolute	Percentage	Seasonal 1922-28, Adjusted, Absolute	Percentage
7.50-10.49......	9	..	......	..	......	..	......	..	......	..	......	..	......	..	......
10.50-13.49......	12	1	.379	1	.379	..	......	..	......	..	......	..	......	..	......
13.50-16.49......	15	16	6.060	..	......	12	14.286	..	......	..	......	..	......	..	......
16.50-19.49......	18	35	13.257	16	6.060	27	32.143	10	11.904	2	2.380	..	......	..	......
19.50-22.49......	21	35	13.257	50	18.939	11	13.095	44	52.380	17	20.238	..	......	..	......
22.50-25.49......	24	30	11.363	37	14.015	10	11.905	23	27.380	14	16.666	7	8.333	3	3.571
25.50-28.49......	27	26	9.848	36	13.636	9	10.715	7	8.333	9	10.714	23	27.380	23	27.380
28.50-31.49......	30	33	12.500	30	11.363	10	11.905	..	......	10	11.904	20	23.809	28	33.333
31.50-34.49......	33	14	5.303	38	14.393	3	3.571	..	......	4	4.761	27	32.142	24	28.571
34.50-37.49......	36	18	6.818	17	6.439	1	1.190	..	......	9	10.714	6	7.142	5	5.951
37.50-40.49......	39	16	6.060	12	4.545	1	1.190	..	......	5	5.952	1	1.190	1	1.190
40.50-43.49......	42	8	3.030	6	2.272	..	......	..	......	3	3.571	..	......	..	......
43.50-46.49......	45	10	3.787	4	1.515	..	......	..	......	5	5.952	..	......	..	......
46.50-49.49......	48	8	3.030	14	5.303	..	......	..	......	5	5.952	..	......	..	......
49.50-52.49......	51	5	1.893	3	1.136	..	......	..	......	1	1.190	..	......	..	......
52.50-55.49......	54	3	1.136	..	......	..	......	..	......	..	......	..	......	..	......
55.50-58.49......	57	..	......	..	......	..	......	..	......	..	......	..	......	..	......
58.50-61.49......	60	3	1.136	..	......	..	......	..	......	..	......	..	......	..	......
61.50-64.49......	63	1	.379	..	......	..	......	..	......	..	......	..	......	..	......
64.50-67.49......	66	1	.379	..	......	..	......	..	......	..	......	..	......	..	......
67.50-70.49......	69	1	.379	..	......	..	......	..	......	..	......	..	......	..	......
70.50-73.49......	72	..	......	..	......	..	......	..	......	..	......	..	......	..	......
Total............		264	99.991	264	99.995	84	100.000	84	99.997	84	99.998	84	99.995	84	99.996
Standard deviation.....		10.73		7.80		5.76		2.37		8.67		3.44		3.06	
Coefficient of variation..		36.61		26.61		26.08		10.73		29.05		11.28		10.01	
Mean..............		29.27				22.07						30.54			
Coefficient of adjustment $\eta=$				27.24				58.85				61.20		65.05	

intense.[1] Therefore, if we designate σ_u = standard deviation of the unadjusted observations and σ_a = standard deviation of the adjusted observations, we have the following relationship:

$$\eta = \frac{\sigma_u - \sigma_a}{\sigma_u}$$

where η = intensity of adjustment.

[1] See also Raymond Pearl, *A Biometrical Study of Egg Production in the Domestic Fowl*, U. S. Department of Agriculture, Washington, D. C., May 28, 1909, Bureau of Animal Industry, Bulletin 110, Part I, pp. 68–69.

The limits of the magnitude of η are between zero and unity. If $\sigma_a=\sigma_u$, then $\sigma_a-\sigma_u$ becomes zero and obviously no adjustment has taken place and therefore η becomes zero; on the other hand, as σ_a approaches zero, $\frac{\sigma_u-\sigma_a}{\sigma_u}$ approaches unity and η approaches the maximum, or 1, hence η varies directly as the intensity of the adjustment.

TABLE IIA

	Seasonal factor	
	1910–16	1922–28
January	129.7	125.0
February	108.4	103.0
March	85.7	74.4
April	70.2	73.1
May	70.2	74.0
June	76.7	73.3
July	77.0	77.0
August	83.5	83.8
September	97.1	99.0
October	113.0	119.0
November	132.6	146.1
December	143.4	152.9
Total	1,200.0	1,200.0

We are now in a position to measure by the respective standard deviations of the various periods the influence which various seasonal factors have on the adjustment of a series of observations.

Therefore, η assumes the following values for the periods indicated:

(a) 1910–31 (seasonal 1910–16)

$$\eta=\frac{\sigma_u-\sigma_a}{\sigma_u}\times 100=\frac{10.72-7.80}{10.72}\times 100=\frac{2.92}{10.72}\times 100=27.24 \text{ per cent}$$

(b) 1910–16 (seasonal 1910–16)

$$\eta=\frac{\sigma_u-\sigma_a}{\sigma_u}\times 100=\frac{5.76-2.37}{5.76}\times 100=\frac{3.39}{5.76}\times 100=58.85 \text{ per cent}$$

(c) 1922–28 (seasonal 1910–16)

$$\eta=\frac{\sigma_u-\sigma_a}{\sigma_u}\times 100=\frac{8.87-3.44}{8.87}\times 100=\frac{5.43}{8.87}\times 100=61.20 \text{ per cent}$$

(d) 1922–28 (seasonal 1922–28)

$$\eta=\frac{\sigma_u-\sigma_a}{\sigma_u}\times 100=\frac{8.87-3.06}{8.87}\times 100=\frac{5.81}{8.87}\times 100=65.05 \text{ per cent}$$

Now when comparing the coefficients of adjustments for the various periods it will be noted that for the period 1910–31 the effect of the adjustment was only 27.24 per cent as compared with the period 1910–16 for which the seasonal was computed and for which the effect of the adjustment was 58.85 per cent. Obviously this must be ex-

pected as all other adjustments outside the base period of the seasonal index are, so to speak, extrapolations. When changes take place in the unadjusted and adjusted units outside the base period of the seasonal index the magnitude of η consequently changes accordingly and may increase or decrease as the case may be.

Making further comparison of the coefficients, we find that the effect of the seasonal on the unadjusted units for the period 1922–28 (based on seasonal 1922–28) amounted to 65.05 per cent and is larger than for the period 1910–16. This conclusion is also supported by the fact that the coefficient of variation for the period 1910–16 equals 10.73, and for the period 1922–28, 10.01. This points to the fact that the seasonal factor for the period 1922–28 must have a larger amplitude and therefore the effect of the adjustment is stronger. In Table IIa we find that the seasonal factor for 1922–28 has actually a larger amplitude than for the period 1910–16.

If the seasonal factor for the 1910–16 period is applied to the unadjusted units of the period 1922–28, the effect is smaller (61.20 per cent) than if the seasonal for the same latter period is used, which substantiates the conclusion that the amplitude for this period has changed.

Whenever the intensity of the seasonal adjustment or the magnitude of η for any other period outside the base period of the seasonal index is smaller or larger by a considerable degree, we must conclude that the relative amplitude of the seasonal has changed and consequently a new seasonal factor should be computed; on the other hand, if η has remained constant, or nearly constant, we deduct that the relative seasonal amplitude has not changed at all, or very little, and furthermore that the adjustments which have been extrapolated beyond the base period of the seasonal are the same, or nearly the same, as if the seasonal index had been computed based on a new period.

The magnitude of η will also change according to the method of computation of the seasonal index, and consequently η may serve as a measure by which it is possible to compare the effect of the intensity of adjustment for various methods for computing the seasonal amplitude.

NOTES

BUSINESS CURVE BASED ON INTEREST RATES AND PRICES

AN ADAPTATION OF THE QUANTITY THEORY OF MONEY

By O. M. Smart

This curve is the result of an experiment to see whether a business curve could be built up from gold, interest rates and prices. Such a curve might have some forecasting value at times when monetary factors were causative, and at other times at least provide a different angle of approach.

The following factors are used:

- G = United States monetary gold stock (plus the silver stock) expressed as per cent of $5,300,000,000 (roughly the average value for the period 1920 to date).
- I = Average of commercial paper and time money rates in New York (adjusted for seasonal variation).
- X = British Exchange (per cent of par adjusted for seasonal variation).
- S = Price of Silver (Shanghai Exchange as per cent of $.6685, 1913 average).
- P = Average of commodity prices (USBLS and *Times Annalist*) and industrial stocks (*Times Annalist*, see 1931 Annual Number).

An equation for business conditions employing these factors was derived from a somewhat broad interpretation of the quantity theory of money. Stated in its usual form this is:

$$\frac{M\ R+D\ R'}{N}=P$$

where
M = Money
R = Rate of turnover of money
D = Deposits
R' = Rate of turnover of deposits
N = Number of transactions
P = Price level

transposing,

$$\frac{M\ R+D\ R'}{P}=N$$

N was assumed to be a measure of business conditions.

P was assumed to be an average of stock and commodity prices.

$M R + D R'$ was replaced by G, I, X, S, on the theory that the monetary gold stock would represent M, the interest rate would reflect the expansion or contraction of the credit structure, and X and S would give adjustments for foreign conditions.

Making the above substitutions we have:

$$\text{Business conditions} = B = f\left(\frac{G, I, X, S}{P}\right).$$

In order to evaluate this function we assumed business conditions to be the American Telephone and Telegraph Company curve, and by a process of trial and error obtained the following equation using data from 1920 to date.

$$B = 18\ G\ I[1.06\ \frac{S}{P} - 2.28\ (1.00 - X)] + .53.$$

This equation was obtained after experimenting with a variety of different forms including exponential functions; it is not, however, by any means the last word. In fact, two other forms have been worked out which give nearly the same results and which may prove eventually to be better.

With this brief description of the construction of the curve, it will be seen that the idea was to see what might be obtained from an attempt to force a fit of these factors into one of the standard business curves based on production. The form of the equation into which the factors were fitted was obtained from the quantity theory of money.

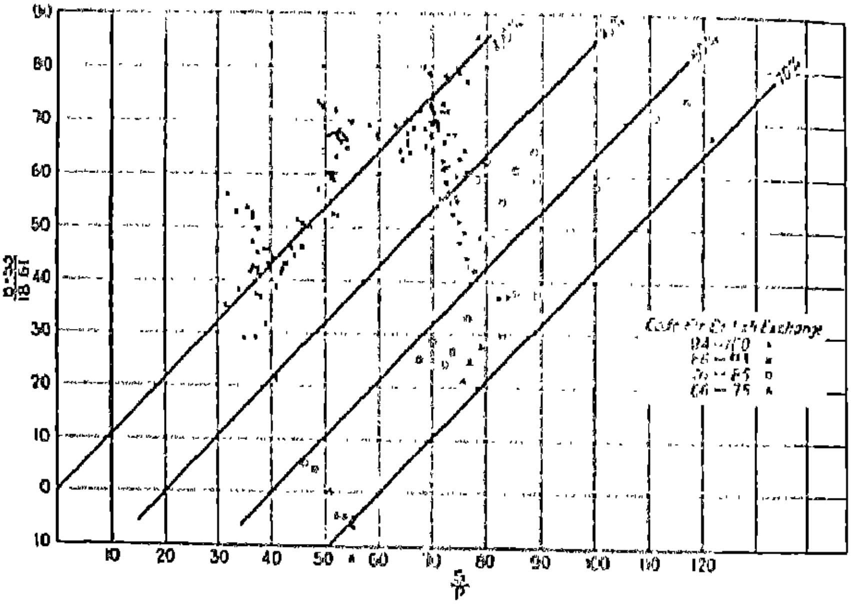
Much might be said both for and against the choice and definition of the items making up this equation. These arguments will be apparent to students of economics. It should be emphasized, however, that it is purely experimental.

The coefficients and final form of this equation depend for their validity solely on the fit obtained. No validity attaches to them as a result of the type of mathematical process followed in getting the equation (since this was purely cut and try). As regards method, however, in order to take some of the mystery out of it, it might be said that it was finally determined by first assuming that it would be of the straight line form and obtaining parameters 18 and .53 by trial and error as follows:

$$B = 18\ f\left(G,\ I,\ X,\ S,\ \frac{1}{P}\right) + .53.$$

The rest of the equation was determined from a three variable graphic set-up in which the three variables were $\frac{S}{P}$, X, and $\frac{B-.53}{18GI}$. This resulted in a system of parallel lines as shown in Chart I. This grouping of terms was used because it results in a rather simple system

CHART I



of parallel equidistant lines, but several other combinations will give equally good results, such as S, X, and $\frac{(B-.53)P}{18GI}$. This combination results in a system of non-parallel lines. There might be an advantage in introducing P twice in the equation with the grouping $\frac{S}{P}$, $\frac{X}{P}$, and $\frac{(B-.53)}{18GI}$.

Our assumption that the short-term interest rate would directly rather than inversely measure the expansion and contraction of the credit structure appears to work very well for the post-war period. For the pre-war period it does not work so well, but decidedly better

than if an inverse relationship were used. Since this curve is primarily one of interest rates as far as month-to-month fluctuations are concerned, this is equivalent to assuming that business and short-term interest rates are directly rather than inversely correlated as is often assumed. Of course, there are plenty of reasons why a set-up based on post-war data would not fit pre-war data but as a matter of fact the lack of fit for the pre-war period seems to consist principally of a lag which might be due to the absence of a central bank. Also there is a wider amplitude of fluctuation which might be due to the same cause.

An obvious source of error would be a reduction in the effectiveness of the gold stock due to hoarding by banks and individuals if this hoarding proceeded far enough to make the short-term interest rate go up in times of slack business. Most of this trouble would be cured by using a four-month lag of interest rates for the period before the War. Error in the curve due to this cause has evidently not been present since the establishment of the Federal Reserve System, and although it may occur in the future, it should be possible to diagnose such a situation when and if it occurs.

The pre-war period as at first plotted from the above equation also showed a lack of fit in having a decidedly lower normal level. The most probable cause of this seemed to be that the price element in the equation included no series for wages. There has been a wide spread between wages and commodity prices since the War that did not exist before the War. It was found that if Carl Snyder's index of wages were averaged with the other two prices, P would be increased by an almost constant amount, about .20 for the period analyzed 1920–1932.

In the equation, therefore, $P' - .20$ can be substituted for P where P' is an equally weighted average of commodity prices, security prices and Carl Snyder's index of wages. This will give practically identical results for the period 1920 to date and correct the difference in level for the pre-war period. Also, it will provide for the effect of further deflation of wages in the future. This change avoids the labor of a complete recalculation of the correlation and suggests that Carl Snyder's Index of General Prices might have been used in the first place.

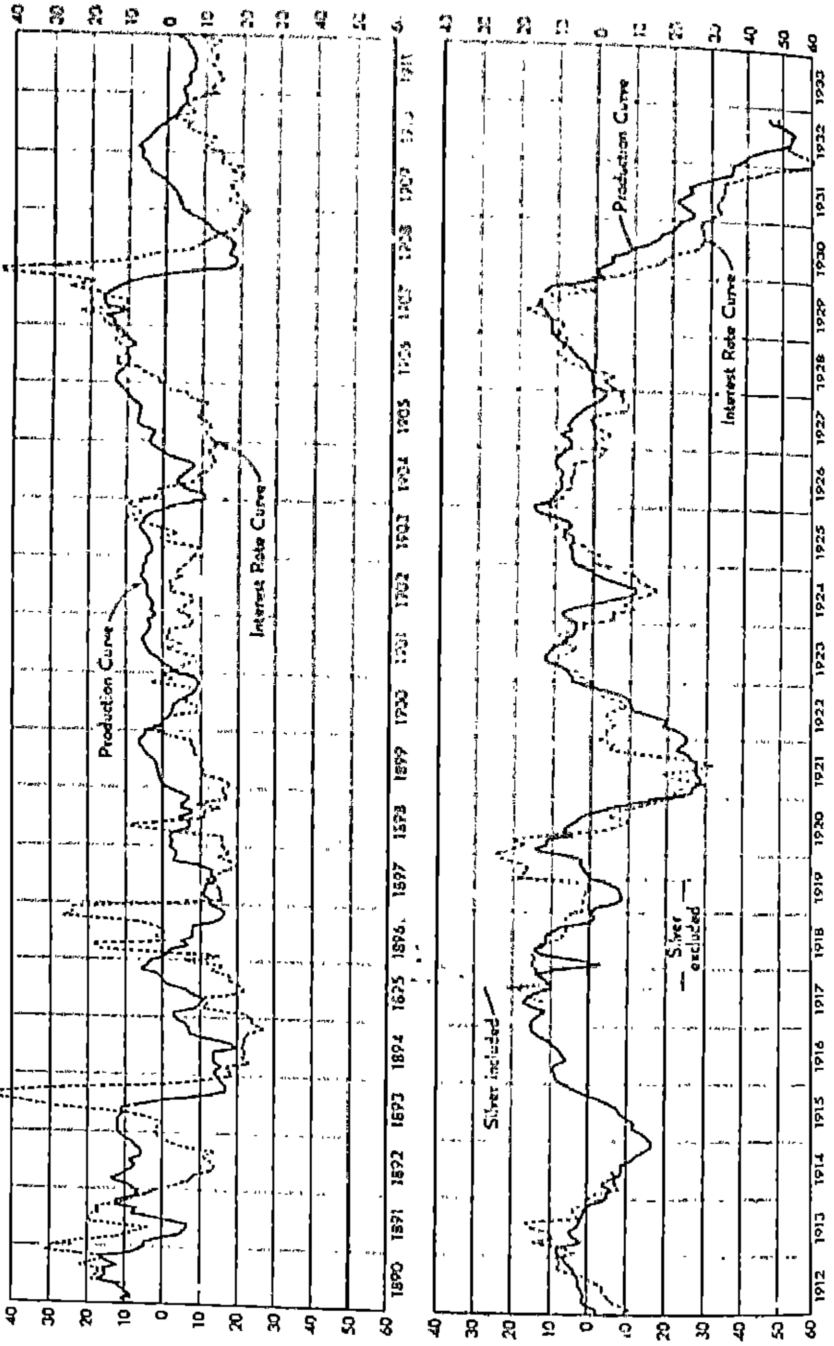
The curve has been plotted therefore from the following equation:

$$B = 18\ GI\left[\frac{1.00S}{P' - .20} - 2.28\ (1 - X)\right] + .53.$$

For the pre-war period an adjustment for the lag of interest rates might have been made and the amplitude of fluctuation cut down but it is thought to be of more interest plotted exactly as it came out.

During the period when gold exports were prohibited in the United

CHART II


Production Curve
Interest Rate Curve
Production Curve
Interest Rate Curve
Silver included
Silver excluded

States, from September, 1917, to June, 1919, the adjustment for both silver and sterling exchange was dropped. The dotted line Chart II shows where the curve would have gone if this had not been done. The fact that the jump and subsequent drop in the curve synchronizes so well with these dates makes it seem plausible that the price of silver has no significance when gold exports are prohibited. As regards sterling the case is not so clear as it was pegged so near par that it would make little difference whether it was included or not.

England went off from a gold basis in May, 1917. It is evident that during the period from July, 1914, to May, 1917, when the gold basis was still in operation, the effect of variations in the exchange was opposite and much greater in degree. An analysis of this period might be interesting but it is not thought worth while to complicate this paper by an attempt to treat it, since wide fluctuations in exchange with the gold basis in operation are normally impossible.

Probably the biggest objection to this curve will come from the inclusion of the price of silver. Without it the correlation falls down quite completely at all important points. It is suggested that its importance as a measure of exchange may be in connection with transfers of gold and silver to India and China rather than trade in ordinary commodities.

Another effect of the inclusion of silver is that no correction for trend is necessary either in the curve itself or any of the components. In this connection attention is called to an article in this JOURNAL, June, 1932, by L. C. Wilcoxen on "World Prices and the Precious Metals."

A great deal of discussion could be given regarding theoretical bases of assumptions made and conclusions which might be drawn, but this would involve going rather deeply into the subject of economics and this article is intended to be simply a presentation of a statistical experiment.

THE RICHARDS-ROOPE TANGENT METER

The idea of using a reflected image for the location of the tangent point of a curve is not new. Charles S. Slichter in his *Elementary Mathematical Analysis* (New York, 1914) page 220, mentions a mirrored ruler for drawing the tangent to any curve and he refers to Gramberg *Technische Messungen* 1911; and Otto Prölss in his *Graphisches Rechnen*, Teubner, Leipzig, 1920, refers to the same method (page 101). These devices do not make direct measurements, however. An instrument[1] for the direct measurement of the tangent function at any point of a curve was first described by Professors Richards and Roope in *Science* March 14, 1930. In conjunction with the Scientific Bureau of the Bausch and Lomb Optical Company, Rochester, New York, Professors Richards and Roope have made some improvements on the instrument reported at that time and the Bausch and Lomb Optical Company is now offering it for sale in this form. The instrument is based on the principle of the reflection of a point through an isosceles prism revolving with a metal ring which in turn holds a disc of glass. The prism is mounted large face down on the glass disc in such a way that the lateral edge is directly in line with the center. The rotable metal disc carries an angle degree scale on one side and a tangent function scale on the other. For the degree scale a vernier is supplied. Tangents to unity (45°) may be read directly within 2/100. The writer investigated the curve $y=7x^2$; $\frac{dy}{dx}=14x$ and found for $x=3$; $\frac{dy}{dx}=42.5$ instead of the actual 42.0 which represents an error of plus 1.10 per cent for this particular reading. The instrument is especially useful in all cases where it is difficult to compute the algebraic expression for a given curve itself and consequently the differential quotient. This occurs frequently in the case of curves of the higher order. A great deal of time can be saved because it is possible to measure rates at intermediate intervals without repeating tedious numerical computations. Doubtless the instrument could be improved by using finer scale divisions. The physical scale lines cut by the dividing machine measure now about 3/10 of a millimeter for both the degree and tangent scale. A circular scale made of the same material as used for slide rule scales and paragon scales would improve visibility and permit much finer graduations.

The engineer, biologist and economist will find the instrument a very convenient tool for determining rates of change of any phenomenon in their particular field.

R. VON HUHN

ECONOMIC CHANGE AND FINANCIAL READJUSTMENT

A dinner meeting of the American Statistical Association was held on Tuesday evening, October 18, 1932, at the Hotel Governor Clinton, Thirty-first Street and Seventh Avenue, New York City. One hundred thirty persons were present.

[1] See Direction Sheet: Use of Richards-Roope Tangent Meter No. 33-10-05. Bausch & Lomb Optical Company, Rochester, New York.

Dr. W. Randolph Burgess, Deputy Governor of the New York Federal Reserve Bank, presided. The general topic for discussion was *Economic Change and Financial Readjustment.*

The first speaker of the evening was Dr. David Friday of A. G. Becker and Company. He spoke on "The Credit Debacle." Dr. Friday began by emphasizing the necessity for studying, more carefully than hitherto, the economic changes which are taking place. We should know more than we do about the rules of growth characterizing various types of industries and also about the effects of such growth. For example, a question of prime importance is what is going to happen to the steel industry. In the metal work of the future, is steel to be replaced largely by alloys?

The speaker stressed the fact that many of the financial difficulties which are now being experienced are merely the products of economic changes of the past. The fashion, at present, is to blame bankers for the failures of the banks which they have managed. The truth is, however, that, in most cases, these banks have failed, not primarily because of the bad management of the bankers, but because of forces over which they have had no control, and the outcome of which neither they, nor others, were in a position to foresee. Those who fought Bryan in 1896 felt that, when free silver was defeated, comparative stability of the price level was assured. Nevertheless, although the gold standard was maintained, the price level quadrupled between 1896 and 1920, and, since the latter date, has been cut more than half. Such change is a far cry from stability. Between 1900 and 1910, the total value of all farms in the United States doubled. In the next decade, this aggregate again doubled. Between 1896 and 1920, banks increased in number from 7,500 to 28,000. Now, more than 10,000 of these have failed. When land values were rising steadily, country bankers invested heavily in farm mortgages, believing these to constitute investments of the highest quality. When they made these investments, practically everyone agreed they were right.

When farm land was selling near the top, C. R. Chambers investigated the relationship between land values and rents. He found that anticipated rentals were being discounted at the customary rate of 5 to 6 per cent. Since most people believed that rentals would advance along a straight line at approximately the gradient followed during the preceding decade, land was valued so highly that current rentals were at the rate of only 3 per cent on the valuation. Life insurance companies, as well as banks, frequently loaned so much money on farms that the entire rent was only large enough to cover interest payments. Few, however, realized that this practice was dangerous. It is now clear that the loans on both rural and urban real estate, made during the period of prosperity, were too high, but this was not evident until the fall of the price level.

For a long time now, rising land values have been accompanied by rising taxation. Between 1900 and 1930, factory wages in Michigan were multiplied by 12. The total land value in the city of Detroit was multiplied by 10 and the total amount of taxes levied, by more than 10. Now that the price level has fallen, the annual tax rate represents 3½ per cent of the value of the land.

The motor age has made it possible for the city resident to live five times as far

out from the center of the city as formerly. This means that 25 times as much land has become available for residential purposes. Can urban land values recover under these conditions? Dr. Friday felt this to be the type of question worthy of very careful investigation.

The second speaker of the evening was Mr. Ivy Lee, who discussed "Some of Our Unsolved Problems" Mr. Lee stated that political leaders, generally, refuse to face the real problems confronting the country. They prefer to deal with questions which are interesting to the public and, as Walter Lippmann says, "What is of interest to the public is seldom interesting to the public."

Mr. Lee expressed the view that the true source of prosperity lies in the maximum exchange of goods on an international basis. Ever since the Armistice, all the nations of the world have been engaged in devising ways and means of impeding the exchange of both goods and money. These obstructions are, in substantial measure, responsible for the depression.

Mr. Lee pointed out that although, on the whole, the United States is, in many respects, a self-contained Nation, this is not true of important sections of the Nation. For example, we produce twice as much cotton as we use. The Texas farmer can market his cotton only if he sells it abroad. It does not help him to know that the foreign trade of the Nation constitutes but 10 per cent of our total trade. If Texas is to prosper, she must be able to sell her cotton abroad.

The second unsolved problem mentioned by Mr. Lee was how to balance world production of and world consumption of leading commodities. The tendency in recent years has been for production to outrun consumption. Certainly there have been few intelligent efforts to organize stability. Some progress has been made in coördinating sugar production with sugar consumption. Such coördination should be extended to all other leading commodities.

The third outstanding problem is that of inter-Allied debts. It is obviously impossible for Europe to pay us in gold. If we wish payment, we must accept goods, yet we erect barriers to prevent entrance of the goods. When Europe borrowed during the War, she borrowed orders to buy goods in the United States. Lord Cecil has suggested that it is only fair that, in payment of the debt, Europe should give to the United States orders to buy goods in Europe. This proposal is worth considering. Someone has said that, as a matter of fact, the whole structure of Allied debts was a corpse before the Lausanne Conference. There it was cremated. The only real question now remaining is when we shall bury the ashes.

The fourth problem touched upon by the speaker was the question of money—the operation of the gold standard. He stated that, before the World War, in many European countries gold circulated about as freely as paper money. Now its employment as a circulating medium has ceased, and it is used only for bank reserves and to settle international balances. The operation of the gold standard in the future must depend upon a new type of coöperation between Central Banks.

What we most need is a stable standard of value, added Mr. Lee. The price level affects fundamentally every phase of our life. The failure to establish a stable price level constitutes, therefore, an indictment on human intelligence.

A pound of copper is always a pound; a gallon of oil is always a gallon; a yard of cloth is always one yard—but a dollar is not always a dollar. Its value is what it will buy—and that constantly changes. We need a fixed standard of deferred payments so that the amount which the debtor is called upon to pay will equal, approximately, the amount which he borrowed. There will not so often be the changing relationship between he who pays and he who receives payment. With the fall in the price level, the face value of debt in the United States is possibly now equal to the total national wealth, although, when the debts were incurred, it represented not more than half of the national wealth. Unless the price level is raised, it is clear that a large proportion of the face value of this vast volume of indebtedness cannot be paid.

The third speaker of the evening was Dr. W. W. Cumberland of Wellington and Company who dealt with "Imprudent Investment." He opened by quoting Governor Roosevelt's contention that public utility rates and securities issued by public utility enterprises ought to be based upon prudent investment, and raised the question as to what is to be considered such. Dr. Cumberland expressed the view that one of the important causes of the depression was failure to handle capital properly. When prices are rising, almost any kind of a loan is safe. When prices are falling, the debtor loses because of the increased burdensomeness of the debt, but the creditor does not always gain because, in many cases, the debtor is unable to pay. Dr. Cumberland laid down the principle that no loan is to be considered productive unless the asset established is greater in value than the money borrowed.

The lender needs security plus a satisfactory yield on his investment. The greater the burden of debt, the less the security. According to Dr. Lionel D. Edie, the total burden of debt in the United States in 1912 amounted to about 27 per cent of the national wealth. If the average rate of interest on this indebtedness was 5 per cent, the total interest was a charge of 8 per cent on the national income. In 1932, however, the total debt had increased to something like 47 per cent of the national wealth and, to pay 5 per cent interest on this amount, requires some 15 per cent of the national income.

Our states and municipalities have borrowed huge sums for public improvements. These improvements have, in many cases, greatly enhanced the value of the property adjoining. Frequently, they have not correspondingly increased the money income of holders of such property. In these cases they have not created income commensurate with increasing interest charges. The increase in value of the property is, therefore, merely an illusion of security behind the loan.

Many of the investments made during the recent period of prosperity are hard to justify. Railroads expended vast sums on improvements made in an effort to offset the effects of competition, but, in many cases, this expenditure has proved unproductive. A large proportion of the earnings ploughed in by leading industrial corporations has yielded no adequate return, but has merely resulted in excess capacity. In such cases, both stockholders and the general public would have been better off if the earnings had been distributed as dividends instead of ploughed in. In general, when a proposed investment by a corporation is not

such that financing can be obtained from the money market, the probabilities are that it is unsound and that corporate funds should not be placed therein.

Mr. Cumberland felt that the view generally held that debt is a normal part of business finance is erroneous. Debts ought to be incurred only in times of emergency, and such debts should be paid off in the next period of prosperity. Loans should have no longer life than the purpose or property in connection with which they are made and all loans should carry rigorous amortization provisions. Were this policy always followed, the danger of having serious depressions would be greatly lessened.

The last regular speaker on the program was Mr. Horace Bowker, President of the American Agricultural Chemical Company. The topic of his address was, "Agricultural and Industrial Stability." He began by stating that the stability of industry is dependent upon the purchasing power of the common people. We cannot have business recovery until consumers are able to buy. One of our greatest difficulties is that the purchasing power of the farmers has been unduly low. When the prices received by the farmers for the things they bought fell without a corresponding reduction in the prices of the goods which they purchased, trouble for industry was in store. The most hopeful feature of the present situation is that the gap between farm prices and the prices of urban products is no longer growing larger.

Mr. Bowker expressed the view that the only way in which to align farm incomes and urban incomes is to increase the efficiency of the farmers. The farmer can make money only if he can reduce costs sufficiently to enable him to compete in the world markets. The surest way in which to reduce costs is to use more fertilizer. Careful investigation shows that those farmers who use an adequate supply of fertilizer are able to produce at not more than half or two-thirds of the average cost per unit of output. For two years farmers have been "soil-mining" to an unprecedented degree. This means lower yields per acre, higher unit production costs and a further decrease in farm purchasing power. Good business policy demands that the usual amount be not diminished, but greatly increased. The Federal Government ought, therefore, to loan to the farmers at least one hundred millions of dollars to be used exclusively for the purchase of fertilizer. Such a loan would be reflected in a decrease in the cost of growing crops and a corresponding increase in farm purchasing power. Such a loan would be self-liquidating within six months after it was made. Enhancement of the farmers' income would mean that he would buy more from the city and hence would help the urban business man.

The discussion was led by Merryle S. Rukeyser, financial writer, and J. Herbert Leighton of the Bush Terminal Company, and was followed by remarks from the floor by a number of speakers. Mr. Leighton raised the question as to whether a Federal loan to farmers, for the purpose of buying fertilizer, would not result in overproduction of farm produce and make the situation worse, rather than better.

Mr. Leighton also mentioned the fact that it is now the fashion, rightly enough, to criticize those statisticians who, in 1929 or earlier, drew lines from the trough of 1921 to the peak then attained, and extended these lines upward into the future

as if they were "trends." Is it not now equally the economic fashion of the day, he asked, to draw lines (verbally) from the peak of 1929 to the summer of 1932 and extend them downward into the future as if they were "trends,"—a fashion perhaps exemplified in some of the evening's addresses? In discussing long-range economic tendencies, the fact that such "trend projection" is verbal and implied rather than graphic and clearly explicit, makes it all the more imperative to be on our guard in a period of uncertainty to differentiate so far as we can between trend and cycle.

The meeting adjourned.

WILLFORD I. KING, *Secretary*

THE COST OF GOVERNMENT IN THE UNITED STATES AND ITS MEASUREMENT

A dinner meeting of the American Statistical Association was held on Tuesday evening, November 29, 1932, at the Hotel Woodstock, 127 West Forty-third Street, New York City. Eighty-seven persons were in attendance. The general topic under discussion was *The Cost of Government in the United States and Its Measurement*.

Professor Thomas S. Adams of Yale University presided. He opened the meeting by saying that, if the credit of the Federal Government is to be maintained, it is necessary to convince a doubting world that we are both able and willing to balance the budget *not at once*, but within a reasonable future period. The problem is as much psychological as financial. Psychologically speaking, the fiscal year 1935 is early enough, provided the financial world is convinced that a real balance will be achieved by that time.

Financially speaking, the short session of Congress should be devoted to the difficult task of reducing public expenditures. The demand for economy is now stronger than it has been at any time during the last fifty years. There is a real question, however, whether any material reduction of expenditures can be achieved. Expenditures can be reduced materially only by decisions of policy. Cheese-paring economies are well worth while in themselves, but they do not materially relieve the strain upon the taxpayer. Such decisions of policy mean cutting down veterans' allowances, appropriations for special construction, grants for education and highways, special appropriations for agriculture and the like. In general, no great reductions in expenditures are to be expected, much as they are to be desired.

From the standpoint of policy, however, the question of balancing the budget and imposing new taxes should be postponed until we know whether Congress and the American people have the resolution to cut federal expenditures materially during the fiscal years 1934–35.

The first regular speaker of the evening was Dr. Roland P. Falkner, who spoke on the subject "Balancing the Federal Budget." He called attention to the fact that the subject might be treated from the viewpoint of international relations, from the viewpoint of the economic effect of huge government issues of bonds, or from the viewpoint of the tax expert. He stated that he would consider it simp'y

as a statistician and try to answer three questions: (1) what the deficit was, (2) how the deficit came about, and (3) what were the prospects of its reduction or elimination.

The deficit in the year 1930–31 amounted to 903 million dollars, in 1931–32 to 2,558 million dollars, and in the current fiscal year appears to be accumulating at about the same rate as in the previous year. The deficit implies a comparison over a more or less extended period of time, usually a fiscal year, and one cannot argue from the events of the first four months of the current fiscal year to the results of the year as a whole, since so much depends on the distribution both of receipts and expenditures within the fiscal period.

Considering the Federal finances from the standpoint of annual or semi-annual operations, the deficit did not appear in the Federal budget until January, 1931. Up to that time the shadow of the depression had not fallen upon the government revenues, which continued to rest largely upon taxes based upon the prosperous incomes of 1929. When the deficit came, it was clearly the result of business depression and not of Congressional ineptitude. Expenditures for 1930–31 were authorized by the Congress of 1929–30, while those for 1931–32 were authorized by the short session Congress which terminated March 4, 1931. When the latter Congress acted, no one could foresee the extent to which business and hence government revenue would decline, and Congressional leaders cannot be legitimately blamed for lack of foresight.

The speaker showed that the increase of expenditures in 1931–32 was attributable in large part to measures taken to combat the depression. Looking to the future, he suggested that, when the time comes that such emergency expenditures can be omitted we should return to approximately the pre-depression level of expenditure. He seriously doubted whether this expenditure of approximately four billion dollars could be materially reduced. Of this sum, approximately one billion dollars is for debt charges which cannot be reduced. Approximately another billion goes to the veterans, and the speaker emphasized the improbability of the success of any effort to reduce the sums heretofore granted to the beneficiaries of veteran relief legislation, though holding that the time had come to check the rapid growth of expenditure for this purpose. Any reduction of expenditure must, therefore, be confined to the remaining two billion dollars, which he characterized as the operating expenses of the government. Temporarily, such operating expenses could be reduced, but not without a marked decrease in the output of governmental services of one kind and another. While the pruning knife might be applied temporarily and the expenditure for government services decreased by decreasing those services, the forces which have led to the expansion of government continue to exist and will sooner or later bring them back into existence. It is more likely that, if anything can be done in the fiscal year 1933–34 to balance the budget, it will be rather through increased taxes than decreased expenditures. Balancing the budget may be a means of promoting the return of prosperity, but a permanent elimination of the Federal deficit is not to be expected until the normal expenditures of the government can be met from the proceeds of normal taxation.

The second speaker of the evening was Mark Graves, Director of the Division

of the Budget of the State of New York. He spoke on "Balancing the State Budget." Mr. Graves began by pointing out that New York State is in a different position from the Federal Government in that the budget must be balanced every year, for such a balance is demanded by the constitution of the State.

The securing of a balanced budget has been rendered difficult by the fact that, during the last year, State revenues have shrunk by 54 millions. This shrinkage is due primarily to the depression, for the taxes upon which State revenues depend are largely affected by business prosperity. For example, the income tax in 1929 yielded 40 millions of dollars. In 1932, though the rates are higher, the yield will be less than half that amount. There has also been a great shrinkage in the revenues derived from stock transfers. The State tax on realty was abolished in 1928. This abolition eliminated one reasonable stable source of steady income. While the depression has caused a great shrinkage in State revenues, expenditures have tended to grow by leaps and bounds. One of the chief of these expenditures is State aid to local governments. Out of the money collected by the State, 50 million dollars is immediately distributed to the various localities. Furthermore, the State subsidizes local schools, roads, health services, reforestation, and old age relief. The amount of aid given to localities by the State for these purposes has risen, in the last ten years, from 40 to 121 millions of dollars. Under the provisions of existing statutes, such State aid will be increased to 135 millions of dollars next year.

Another prime difficulty in balancing the State budget arises from the fact that the people of the State persist in voting in new bond issues, and these open issues naturally increase the interest charges. In recent years, bonds have been voted for the bonus to soldiers, and for State hospitals, parks, prisons, and the elimination of grade crossings. In the recent election, 30 millions more of bonds were voted for unemployment relief. As a direct result of this policy, debt charges are rising from 25 millions this year to 32 millions next year.

After the State has distributed money to localities and has paid the required debt charges, it must then meet its own current expenses. It supports 81 thousand people in institutions at a cost of $430 per person per annum. Appropriations have been reduced until only six cents is allowed for each meal. It seems difficult to cut the figure lower. However, these institutions cost 38 million dollars a year. Seven colleges and other schools operated by the State are attended by sixteen thousand students. Their education costs 6 million dollars per annum. Three million dollars are spent to operate the barge canal. It produces no revenue, for the law provides that its services shall be free to the public. It takes 9 million dollars each year to keep the highways in repair. Two millions are spent on the legislature; 4 millions on the State courts; building upkeep requires 3 millions; 14 millions are spent for new buildings, new highways and other improvements. This leaves 29 millions to cover the cost of all other departments of the State government. Apparently the only feasible place to make any large reduction in State disbursements is to reduce the amounts paid to local governments. Unfortunately such reduction is not likely to be of material benefit to the taxpayers for the local governments as well as the State government are in financial difficulties. If the State stops collecting these

revenues for them, they will doubtless levy them themselves. However, if the State does not reduce disbursements to localities, an increase in State taxes seems inevitable.

The third speaker of the evening was Gaylord C. Cummin, President of the Municipal Securities Service. The subject of his address was "Balancing the Municipal Budget." He began by pointing out that, in the past, the usual custom has been to decide how much money the municipality needed and then to determine what taxes must be levied in order to cover this amount. At present, however, this policy is breaking down and municipalities are being forced to ask first how much taxes they can collect and later to determine what to do with this limited revenue.

The first thing that municipal authorities usually do when confronted with financial difficulties is to look for some method of shifting taxes which will produce more revenue without increasing the burden resting upon the citizen. Such a search is much like looking for the pot of gold at the end of the rainbow. The only way to reduce the burden upon the taxpayers is to cut expenses.

Municipal authorities usually believe it essential to balance the local budget. However, they are often satisfied with a nominal rather than an actual balance. In many cases, they do not hesitate to over-estimate receipts or to under-estimate expenditures. Later on they borrow to meet the resulting deficit.

Of course we all want economy in those phases of government in which we are not interested. However, we object strenuously to reducing either our own salaries or those of our friends, and we certainly do not desire to have any of our friends dismissed from public positions. Yet, the only practical way in which most municipalities can reduce expenses is to reduce the amount paid out in wages or salaries.

Even when a city sincerely desires to reduce expenses, it frequently is prevented from doing so by mandatory laws passed by the legislature fixing the number of employees and their respective salaries. Most of these laws were passed in the hope of preventing extravagance. Now they also prevent economy.

Another hindrance to an economic program is our system of checks and balances in government. Responsibility is much divided. Each officer in a department strives vigorously to place upon an officer in some other department the responsibility for reduction in payroll, and avoids taking on responsibility for such unpopular measures. As a rule, public officials are interested primarily in trying to give the public what it wants. The public usually wants more expenditures rather than less.

The most powerful force which, at present, is working toward a reduction in municipal expenditures is the refusal on the part of investors in municipal securities to buy the bonds of those municipalities having unbalanced budgets. In those cities in which the situation is so bad that borrowing is imperative, the views of these potential investors command real respect.

In introducing the next speaker, Professor Adams called attention to the fact that, in some cases, very remarkable reductions may be made in municipal expenditures without disastrous results. For example, he cited the case of one municipality which recently reduced its expenses from $1,400,000 to less than

$400,000 per annum, without seriously impairing the work of the governmental machinery.

The discussion of the papers of the preceding speakers was opened by Professor Robert M. Haig, Professor of Political Economy at Columbia University. He stated that the nominal Federal deficit will probably amount to between five and five and a half billions of dollars by June 30, 1933. Of this amount, however, some one and a quarter billions represents reduction of the public debt and one-half a billion has been invested in the Reconstruction Finance Corporation. How much of this investment will eventually be recovered is, of course, problematical. It seems probable that capital outlays may account for another billion dollars. *The true deficit, then, up to June 30, 1933, will probably be in* the neighborhood of from two to two and a half billions. In proportion to the wealth of the United States, this is a relatively small amount: certainly the credit of the Federal Government is still unimpaired. That such is the case is illustrated by the fact that the interest rates on its securities are abnormally low, although, at the same time, municipalities with unbalanced budgets must pay high rates of interest for loans.

The policy of letting the deficit continue until the end of the depression may be viewed with equanimity if expenditures can be kept within reasonable bounds. The danger is that Congress may become reconciled to the existence of an unbalanced budget and spend money recklessly.

The probabilities are that the budget will be balanced by levying new taxes rather than by decreasing expenses. Professor Haig was of the opinion that an income tax reaching down to the lower levels of income would be preferable to a sales tax, because of the regressive character of the latter. A logical system of taxation would provide that, in the case of variable taxes, a considerable proportion of the revenues in good years be held in reserve to be used to cover expenses in bad years. It is, however, difficult to put such a system into practice.

Professor Haig expressed the view that there was much more possibility of making substantial reductions in expenditures in New York City than in the case of the Federal Government. He saw no reason for not placing municipal services such as the subway on a self-sustaining basis.

After a brief discussion from the floor, the meeting adjourned.

WILLFORD I. KING, *Secretary*

PROGRESS OF WORK IN THE CENSUS BUREAU

CENSUS OF INSTITUTIONS

The census of defective, dependent, and delinquent classes in institutions is one of the more important of the decennial inquiries which the Census Bureau makes in the period between the decennial censuses of population. In this inquiry, which is to cover the calendar year 1933, it is proposed to include the following classes:

1. Sentenced prisoners in State and Federal prisons. (This is now an annual inquiry.)
2. Sentenced prisoners in county and municipal jails and workhouses.
3. Juvenile delinquents in reformatories and similar institutions.

4. Patients in hospitals for mental disease. (This is now an annual inquiry so far as concerns State institutions; the number of institutions under private and local governmental supervision, to be added for 1933, is relatively small.)
5. Inmates in institutions for the feeble minded and epileptic. (This is now an annual inquiry so far as concerns State institutions; the number of other institutions is relatively small.)
6. Paupers in almshouses.
7. Inmates of institutions, other than almshouses, for the care of adults.
8. Inmates in institutions for dependent children.
9. Children under the supervision of child-placing organizations.

The inquiry made 10 years ago, covering parts of the years 1922 and 1923, included certain other types of institutions, namely, general medical hospitals, dispensaries, humane societies, day nurseries, and certain detention homes and other private agencies working with juvenile delinquents. For 1933 it has been proposed that the inquiry be limited in the main to those institutions which represent the more or less permanent place of residence of certain classes of the population; hence the omission of the types of institutions just named.

By reason of limited appropriations it will probably be necessary to restrict also the scope of the inquiry for some of the institutions which are canvassed, as compared with that of 1922–23. The attempt was made then, for example, to obtain an individual card record for each pauper in an almshouse at the beginning of the year or admitted during the year. It seems likely under present circumstances this inquiry will be confined to a general report showing the movement of population during the year for each institution as a whole, with a very simple classification of the inmates in the institution on a given date.

Three of the nine classes of institutions for which the decennial census is projected are covered wholly or in part by an annual inquiry which will be continued for the year 1933. For State and Federal prisons the decennial census will differ very little from the annual census. For the insane hospitals the inquiry addressed to the State institutions will be expanded somewhat from the annual basis, mainly through the collection of individual reports in place of the tabulated returns made each year; and this inquiry will be extended to cover hospitals for the mentally diseased under other than State direction. Similar changes will be made in the regular program for the institutions for the feeble minded and epileptic.

The inquiry with respect to juvenile offenders in reformatories will follow in general the plan of the annual inquiry for the State prisons, with proper modifications to suit the conditions obtaining in the institutions for juvenile offenders.

The most extensive single inquiry in the decennial census of institutions will be that relating to prisoners in county and municipal jails. In this inquiry it is proposed to obtain individual returns for prisoners in the institution at the beginning of the year, for those admitted and discharged during the year, and for those remaining in the institution at the end of the year, with a classification by sex, color, nativity, age, offense, sentence, number of prior commitments, time served, and method of discharge—whether by expiration of sentence, payment of fine, parole, pardon, or otherwise. One schedule has been devised to carry all of this information, and in order to facilitate the collection of the data, it is proposed to distribute the schedules at the beginning of the year 1933 and request that

they be filled out from day to day as the prisoners are discharged. This will leave for completion at the end of the year only the schedules for those prisoners in the institution at that time, a relatively small number as compared with the commitments and discharges for the year.

For the almshouses and other classes of charitable institutions it is proposed to obtain, as already indicated, a summarized schedule for the institution, with no attempt to get individual returns for population or commitments. For these institutions the schedules will not be sent out until the latter part of 1933, since they cannot be filled out until the completion of the year which they are to cover.

One important change in the general method of procedure for the institutional census, as compared with that of 1922–23, is that no payment is to be made to the institutions or their employees for filling out the schedules. Experience with other inquiries makes it seem reasonable to expect that satisfactory returns can be secured on the new basis. It has been difficult to arrange rates of payment for such schedules which are fair to all concerned, by reason of the widely differing conditions in each institution; and in many cases the actual expense of making the remittance in the form of a Treasury draft for the small amount due an individual has exceeded the amount of the remittance itself. Further, for most of the institutions the schedules requested for 1933 will be far simpler than those of 10 years earlier and can be filled out in a fraction of the time then required.

The work so far accomplished on the decennial census of institutions includes the printing of the schedule for county and municipal jails; the preparation of the mailing lists for these institutions; and the general revision of the schedules for the annual inquiries which are to be expanded for the year 1933.

MISCELLANEOUS NOTES

The New York Supper Discussion Meetings.—The Uptown and Downtown Luncheon Meetings of the Association, held during June and July of this year, were so successful in providing brief gatherings consisting of short "idea talks" followed by intimate and pertinent discussion of these ideas from the floor, that it was decided to revive this type of meeting in the fall. The Uptown and Downtown Committees felt, however, that many interested persons were kept from these meetings by the necessary shortness of the noon period, as well as by business engagements during the day.

It was decided, therefore, to change these two luncheon meetings each month to a single supper meeting each month, this latter to alternate in time with the regular dinner meetings of the Association. The essential features of the luncheon meetings will be preserved in these new supper meetings: brevity of the stated talks and discussions, extensive ensuing discussion from the floor, popular prices of admission, "leave early, if you must, without prejudice," and supper (not a dinner) served unostentatiously during the discussion period.

The first Supper Discussion Meeting was held on Monday, November 14th at 5:30 p. m., in the main downstairs dining room of Busto's Restaurant, 11 Stone Street. Mr. Leon Henderson of the Russell Sage Foundation presided. The Committee was fortunate in obtaining Dr. Leo Wolman as principal speaker on the subject "Public Budgets and the Relief Program." Both at Columbia and the National Bureau of Economic Research, Dr. Wolman has made authoritative studies on this subject.

He spoke for about 15 minutes. The discussion, presenting other points of view, was opened by Mr. Arthur Gayer, of Barnard College, and the National Bureau of Economic Research, and Mr. Arthur Dodge, of the Regional Banking and Industrial Committee. Each of these gentlemen talked for 10 minutes. They were followed by discussion from the floor.

The Albany Chapter.—The Albany Chapter is conducting again this year classes in statistics. Dr. David M. Schneider of the New York State Department of Social Welfare is responsible for the class in elementary statistics. Mr. Sidney W. Wilcox of the New York State Department of Labor is meeting with the class in advanced statistics. The enrolment is approximately 40 and consists mostly of state employees.

The Chicago Chapter. The Chicago Chapter held its first dinner meeting of the 1932–33 season on Friday, October 14, with about 50 members and guests in attendance. The topic of the evening "An Analysis of the Personal and Business Failures in the Chicago Region" was given by Professor John H. Cover of the School of Business, University of Chicago. For the past two years, Professor Cover has been the director of the Survey of Business Adjustment, which has been conducted jointly by the University of Chicago with the United States Department of Commerce. In this capacity he made a case and statistical analysis of 1,800 personal and business failures and to the methods of rehabilitation such as bankruptcy, receivership, and creditor assignment. He also made a study of the efforts that are being made to keep business solvent, such as creditor management, and of the way the liquidated cases have rehabilitated themselves. In his introductory remarks he pointed out that there is a lag between the number of failures and business conditions, due to creditors being loath to hasten the process of liquidation; also, that the low point of failures occurs in August or September and the high point in January. Among the causes of business failures he cited (1) neighborhood conditions, which include closing down of plants, bank failures, and unemployment among customers; (2) chain store competition; (3) excessive overhead, which includes principally fixed costs, excessive withdrawals for personal use, and rental; (4) lack of business experience; and (5) lack of capital with which to operate after the business has been opened. The principal causes of personal failures he gave as (1) living beyond income; (2) former business debts; (3) speculation, which includes that in stocks, real estate, and home; (4) signing personal notes; (5) unemployment; (6) part-time employment; (7) illness in family; and (8) illness of bankrupt. Professor Cover quoted much interesting data on concentration of failures in certain sections of the city, the per cent of unemployment in these sections, rents paid, and nativity of the population. Among other things, he stated that the statistical methods employed showed no correlation between the causes of business failures and business conditions; in consumer areas, there was no correlation between the increase in unemployment and personal bankruptcies. In studying the possibilities of rehabilitation, two economic conditions must be faced: price stabilization and security of employment. In the business group, measures of fitness are needed before allowing the establishment of a business; there must be some measure and control of personnel equipment—perhaps a license; and an adequate credit investigation is needed, one that will not only take cognizance of net sales, but also will furnish an adequate gauge of the amount of credit extension to be allowed. A fourth need is coöperative management. From the consumers' standpoint, there should be (1) a development of consumer credit at reduced rates; (2) state medicine; and (3) a consumer coöperative movement. There

is also need of a much less formal method of liquidation than bankruptcy provides, and the elimination of a large group of practising lawyers.

On Tuesday evening, November 22, Mr. Donald R. Cowan, Economist of Swift and Company and instructor in marketing analysis at Northwestern University, gave us the interesting results of a three-year study of wholesale marketing operations to determine the comparative profitableness of selling large and small dealers, different dealer types, and various products. Through the free use of charts, he illustrated how the law of diminishing returns is encountered in selling efforts, coverage of territory, and the number of products handled. Covering too much territory and too many dealers, duplicating selling and advertising efforts, and attempting to sell too many products, were among the major problems encountered in the study. Both statistical and accounting methods were used in the study, so that the result obtained was a rare amalgam of theory and practice.

The Cleveland Chapter.—Miss Mildred M. Hickman, Placement Supervisor, Cleveland Board of Education, was the speaker at the October meeting of the Business Statistics Section of the Cleveland Chapter. Her subject was, "Statistics as an Aid to Education." The talk was illustrated with some very interesting data and charts.

The group reviewed the annual conference of the Harvard Economic Society at its November meeting. The discussion was led by Mr. J. B. Anderson of the Cleveland Federal Reserve Bank and by Mr. B. B. Smith of the Cleveland Trust Company.

An enlightening talk on the work of the Reconstruction Finance Corporation was given at the December meeting by Mr. F. S. Callandar, assistant manager of the Reconstruction Finance Corporation in Cleveland.

The Los Angeles Chapter.—On Wednesday, October 19, 1932, at a dinner meeting, Dr. John Park Young of Occidental College, an authority on public finance, gave his views on the effects of cancellation of World War debts, his subject being "The Financial Interests of the United States." Dr. Young claimed that with respect to South American loans, financial interests in the United States with an eye to the profits from commissions to be earned, loaned more to Latin American countries than their needs justified and beyond their capacity to pay at maturity. Consequently many issues of Latin American bonds will be defaulted or refunded at less than face value with losses to the American investor. He contended that European nations for the most part insist on tying together reparations and World War debts. They conceive, thereby, the idea that they may shift their responsibility for their war debts to the Germans who are generally expected to pay these debts. It is the claim of the cancellationists that the war debts are based upon war time values for commodities and that these work a hardship upon the present ability to pay. While this may be more or less true, in general such is not the case inasmuch as the original debts have been scaled down to approximately the present level of commodity prices. All of these nations by proper financial management and the reduction of certain other expenditures, particularly armaments, would be able to meet these obligations. For various political reasons, principally because they wish to maintain political security they will refuse to do this. The United States Government, unless it is able to collect these debts from its European debtors must pay for its own obligations through taxation of its own citizens. The private debts of the European states, municipalities and corporations are mostly all short term note obligations and have no connection with intergovernmental debts although European argument tends to confuse the two. In all likelihood these will be met at maturity because they are not as complicated as

the intergovernmental debts nor are they befogged with political ramifications. Dr. Young believes that the intergovernmental debts will never be completely paid, with the result that the American taxpayer must necessarily shoulder the burdens of the cost of the World War.

At a dinner meeting on Tuesday January 3, 1933, Mr. M. H. Jensen of the International Smelting Company of Salt Lake City spoke on "Silver and its Relation to World Finance and Money." Mr. Jensen outlined the growth of the need for money as a medium of exchange and the invention of credit as the supply of gold and silver became inadequate for the needs of world trade. He further presented reasons why silver is best suited to the monetary needs of the backward nations. Their governments are not sound enough to produce a currency system which will maintain confidence to operate successfully, nor is the annual per capita income large enough to be easily measured in gold. With silver, however, this yearly income is easily observable as a measure of wealth. One of the weaknesses of gold as a basis for an international money is that because of its rarity an individual, a group of individuals, or a nation may sterilize by withdrawing it from the world markets where it acts as a basis for credit. When such sterilization occurs, a liquidation of values follows with a resulting depression. Further sterilization of gold is brought about through hoarding. This process may continue to the point where gold no longer acts as a basis for credit with the result that another commodity is sought as a basis for credit. It is a belief of some silver producers that this may eventually come about and it is hoped that silver will be used as a money basis.

The Pittsburgh Chapter.—An unusual opportunity to hear first-hand discussion of European conditions was offered at the luncheon meeting of the Chapter held at the Harvard-Yale-Princeton Club, Thursday, October 27. Mr. G. E. McLaughlin, of the Bureau of Business Research, University of Pittsburgh, who had just returned from a year's residence in Germany, discussed the economic and political situation in that country. Dr. R. J. Watkins, who had just returned from a four months' tour of Europe, presided at the meeting and led the discussion. The annual forecasts were presented, covering the twelve months beginning with October.

The November meeting was held on Wednesday, the 23rd, at noon. Mr. F. F. Stephan, Director of the Bureau of Social Research, spoke on "An Analysis of Census Data and Their Suggested Uses."

The final meeting of the year was held on Thursday, December 22. A most interesting discussion on the war debt problem was led by Professors Marion K. McKay and Francis D. Tyson, Professors of Economics of the University of Pittsburgh, before a representative group of approximately fifty engineers, economists and statisticians.

Dr. Marion K. McKay's topic was "The Background and Present Status of the War Debts." He analyzed the original debt figures and the statistics of the present funding arrangements nation by nation, made on the basis of estimated capacity to pay, up to 1925. He argued the necessity of sound scaling down the debts in keeping with the fall in the price levels, which has increased the burden of debt payments by about 40 per cent. He suggested that Mr. Hoover's plea for a new funding commission was belated.

Professor Francis D. Tyson's topic was "A Formula for War Debt Settlement." He stated that the problem was now a political, and not an economic one. "The economic evidence is in; our economists and most of the bankers have known since Versailles that the vast sums of reparations and debts could not be paid. The depression revealed the fiction of payment with the ending of our loans to Germany."

Professor Tyson pointed out popular fallacies on the issue: (1) There is no choice between receiving in full, or scaling down the debt, as congressional utterances would indicate. (2) Senator Borah's promise of arms reduction in return for debt reduction is quixotic. (3) *Reduction is not only necessary to the allies, but is vital to our own interests.* Default is the sole alternative, and it may endanger the structure of commercial debts, and further impair international trend and finance. (4) If possible, we must get debts and reparations, which are inextricably connected both economically and politically, *out of the way before the World Economic Conference meets.* That conference must deal with the vast problems of trade barriers and monetary stability with the resumption of foreign investment. A simple issue like the debts should be solved first.

Professor Tyson preferred *finding a formula of settlement by State Department* negotiations, since approval of a new fund commission by Congress seems now impracticable. He suggested the applicability of the Lausanne reparation settlement to the debt issue. This would permit an immediate capital settlement by the issuing of bonds in the international money markets. Those who insist Europe can pay could not logically contend such bonds could not be floated. The proceeds could be used for investment to aid foreign trade revival for the United States. Such a formula could be interpreted by politicians as no surrender on the debt issue, but would really mark the end of the request for impossible payments and take the first vital step toward world economic recovery.

The San Francisco Chapter.—The twenty-fifth dinner meeting of the San Francisco Chapter was held on Thursday, October 20, 1932, at the Bellevue Hotel in San Francisco. This being the annual meeting, the report of the District Secretary was presented and approved. Officers elected for the coming year were H. R. Tolley, Director of the Giannini Foundation, University of California, President; B. F. Haley, Department of Economics, Stanford University, as Vice-President; and Robert W. Bachelor, Federal Reserve Bank Building, San Francisco, nominated to the national Association as District Secretary.

The topic for the evening was "A Critical Appraisal of Current Measures of the General Price Level and of the Value of Money." The speakers were H. J. Stover and Elmer Braun, both of the Giannini Foundation of Agricultural Economics, University of California. The discussion was presented in three main divisions: 1. The relation of the general price level to the value of money; 2. Comparison of current indexes of the general price level such as the Bureau of Labor Statistics wholesale price level, retail price level, cost of living index, and Snyder's index of the general price level; 3. Relation of general price level to the prices of individual goods.

Dr. Stover discussed the relation of the general price level to the value of money. He reviewed the past and present views as to the value of money, and discussed the early attempts to measure mathematically changes in prices and the value of money. He reviewed the controversies as to the statistical methods to be followed, the kinds of averages which were appropriate, and the selection of the price quotations entering into the index numbers. He then discussed the value of money to the individual, based upon the individual budgets and standards of living, and pointed out the dangers of using a budget based upon the distant past. Changing qualities of the same article, the greater durability built into products, and other factors which make the construction of index numbers hazardous were pointed out. Mr. Braun made a detailed comparison of the components of each of the leading price indexes currently published. He discussed the purpose of each type of index, as outlined by the agency

constructing and publishing such information. He brought out the differences between indexes and the reasons therefor. He warned against using an index for a purpose for which it had never been intended.

The two speakers then jointly led a discussion on the relation of the general price level to the prices of individual goods. Recent experience in price analysis was reviewed, especially in relation to California agricultural commodities. Other topics were touched upon.

United States Bureau of Labor Statistics. A survey of unemployment-benefit plans and of unemployment-insurance systems in the United States and foreign countries during 1931 and 1932 was made by the Bureau, and the information obtained was published in the *Monthly Labor Review* for December, 1932, and January, 1933. This supplements the study made in the spring of 1931 and published as Bulletin No. 544.

A comprehensive inquiry was made by the Bureau as to the extent to which the 5-day week has been permanently adopted in American industry. One part of the study summarizes data for 44,025 establishments having 3,848,349 employees and representing 102 industries or industry groups; the other part shows the extent to which the 5-day week is provided for in collective agreements between employers and organized labor, a total union membership of 595,367 being represented.

A study of the value and kind of goods produced by convict labor in the United States is in progress, the field work being practically completed. The report will show the systems under which the goods are produced and disposed of, together with the number of convicts employed.

An analysis of elapsed time in building construction in 11 cities was completed in the latter part of 1932. The results, published in the *Review* for January, 1933, show the length of time elapsing between the date of issuance of a building permit and the date work was started on the building; the time elapsing between the date work was started and the date the building was ready for occupancy; and the number and per cent of lapsed permits.

The Bureau is continuing its investigations of the effects of technological changes upon employment, the automobile-tire industry, the slaughtering and meat-packing industry, and road building being reported upon in recent issues of the *Review*. A digest of the material on technological changes and labor displacement, published during the past several years by the Bureau, was given in the November *Review*.

Data on wages and hours of labor in glass manufacture, in bituminous coal mining, and in police and fire departments of the larger cities, and on wages and hours of common street labor hired by cities, are being collected. Summary reports on wages and hours during 1932 in the hosiery and underwear industry and in the clothing industry have been published.

Other topics which have been the subject of special study and of articles in the *Review* included the legal restrictions on the hours of labor of men; and laws regulating hours of labor of motor-bus drivers; the period of waiting time required under workmen's compensation laws; costs of dwelling units in various cities, as shown by building permits; and workmen's compensation and other labor legislation of 1932.

Women's Bureau, United States Department of Labor. The Bureau has published a study made by students of the Bryn Mawr Summer School of changes in their own living conditions forced by unemployment during the 12 months preceding the summer of 1932. The survey covers 109 students, from 17 states and distributed among the major industrial groups with over half in some branch of the clothing trades.

A report on the *installation and maintenance of toilet facilities in places of employment* has been completed by the Bureau and constitutes the third in a series of handbooks on industrial standards. The bulletin discusses factors of importance in the provision of suitable toilet facilities. The various types of statutes, rules, orders, and recommendations in effect in the states are classified in regard to method and scope.

A report has been published recently by the Women's Bureau on the employment of women and the hazards of lead exposure in vitreous enameling. Forty-seven plants, practically all making stoves, were visited, and 686 women then or recently employed were interviewed in their homes. The survey was made with the assistance of Dr. Alice Hamilton, assistant professor of industrial medicine at Harvard Medical School. The U. S. Bureau of Standards coöperated by analyzing samples of enamel from firms supplying such samples where the lead content was unknown.

The Pennsylvania Department of Labor and Industry.—The Department has begun a study of low wages and long hours of labor in the textile and clothing industries. The results of this survey will be available about the end of March.

Beginning January 1, 1932, new standards for statistics of public employment offices were put into effect. These revised standards are to be effective only until the final recommendations of the American Statistical Association's Committee on Governmental Labor Statistics are made. The plan adopted on a temporary basis, however, does provide consistent classifications and definitions for the recording of applications, openings, and placements not hitherto available.

The Department has begun the collection of monthly employment and payroll information from banks, insurance, and real estate firms in Pennsylvania. Initial returns indicate that the Department will be able to provide information for this "white-collar" group for more than 600 firms employing approximately 17,000 workers.

The State Committee on Unemployment Reserves will present its recommendations to Governor Pinchot during March.

The Commission on Compensation for Industrial Disease also expects to make its recommendations to the Governor in March.

The Brookings Institution. Since the first of the year the radio program on current economic and governmental problems directed by the Brookings Institution has been as follows: January 7, How Shall We Buy in 1933, Leverett S. Lyon and Mrs. Harris T. Baldwin; January 14, Your Tax Bills, Benjamin P. Whitaker and Richard M. Boeckel; January 21, The Farmer Never Quits, Edwin G. Nourse and Charles G. Ross; January 28, Don't Break the Farmer's Back, Edwin G. Nourse, Benjamin P. Marsh, and Nils Olsen; February 4, What Does Technocracy Offer, Charles O. Hardy and Felix Morley; February 11, Can Public Works Stop Depression, Otto T. Mallery and Isador Lubin; February 18, Financial Reconstruction, Charles O. Hardy and Edwin A. Lamke; February 25, Governmental Reorganization, Lewis Meriam and Miss Ruth Finney; March 4, Problems of the Next Four Years, Lewis L. Lorwin and William Hard; March 11, An American Industrial Policy, Lewis L. Lorwin and Otto S. Beyer; March 18, Can We Afford to be Sick, Lewellyn F. Barker, Harry Moore, and Watson Davis; and March 25, The Transportation Problem, Harold G. Moulton. Six earlier broadcasts in the series were given during November and December, and six additional addresses will be delivered on successive Saturday evenings from April 1 through May 6. To insure informality these broadcasts are presented in the form of

lively discussions and round tables. The addresses are published in pamphlet form and are obtainable from the University of Chicago Press.

Felix Morley, of the Institution staff, will be on leave of absence during March, in order to coöperate in launching the Carnegie-financed public forums in Des Moines. Mr. Morley was one of the first five discussion group leaders selected by the Des Moines Board of Education for this purpose.

Dr. Henry Erdman, Professor of Marketing in the Giannini Foundation of the University of California, is spending a half year's sabbatical leave in Washington, D. C. He is making his headquarters at the Brookings Institution and is spending his time in the study of recent developments in marketing and coöperative organization.

Dr. Tracy E. Thompson, who has been on leave from Ohio State University as Industrial Analyst in the Bureau of the Census, will remain in Washington during the winter months on appointment with the Institute of Economics. Dr. Nathanael H. Engle, who served as Marketing Expert with the Census of Distribution, is now employed on the staff of the Institute of Economics.

In the Institute of Economics the following research projects have recently been brought to completion: Advertising Allowances: A Phase of the Price-Making Process by Leverett S. Lyon; Ten Years of the Federal Intermediate Credit System by Frieda Baird and Claude L. Benner; and American Federation of Labor by Lewis L. Lorwin.

Dr. Laurence F. Schmeckebier of the Institute for Government Research is assisting at the Bureau of Naturalization in the preparation of a detailed analytical report of the statistics on naturalization for the fiscal years 1907–10.

The following are collaborating with H. G. Moulton in the study of the American Transportation Problem, now being prepared in connection with the work of the National Transportation Committee: Frieda Baird, Charles Dearing, Paul David, Wilfred Eldred, Ralph Fogg, Charles O. Hardy, Lloyd C. Hoeltzel, S. Kobe, Ralph L. Dewey, Charles W. Eliot 2d, Edwin A. Lahnke, Adah L. Lee, Isador Lubin, Fred W. Powell, Porter R. Taylor, C. Warner Tufts, and Benjamin P. Whitaker.

Personals

Stuart A. Rice, Professor of Sociology and Statistics at the University of Pennsylvania and our Association's new President, has been given a leave of absence for one year from the latter institution during which he is a Visiting Professor of Sociology at the University of Chicago. During the Fall, Winter and Spring Quarters Mr. Rice's schedule includes courses on Introductory Statistics, Scientific Methods in Social Science, Social Effects of Communication and Quantitative Methods in Politics.

J. Frederic Dewhurst, chief of the Division of Statistical Research of the Commerce Department and member of the United States delegation to the preparatory meeting on the World Economic Conference, has left the government service to become associated with the American Iron and Steel Institute in New York. In leaving the department Mr. Dewhurst follows his former chief, Secretary Lamont, who resigned his Cabinet post to become President of the Institute. He was to have returned to the general sessions of the World Economic Conference next Summer with Louis Domeratzky, also of the Commerce Department. Professor Dewhurst was formerly a member of the faculty of the Wharton School of the University of Pennsylvania, and of the staff of the Federal Reserve Bank of Philadelphia.

Obituary Note

Edwin Gruhl, President of the North American Company, died in January of coronary thrombosis at his residence, 975 Park Avenue, New York City. His promo-

tion to the Presidency of the Company last April marked the climax of a continuous service with it that began nearly twenty-one years ago, when he was appointed assistant to the Vice-President. In 1914 he was made Assistant to the President, in 1920 Vice-President, and later the post of general manager was added to his duties.

His entrance into high executive corporative work followed a comparatively brief period of intensive study of public utilities. He at first became a member of the staff of the engineering department of the Wisconsin State Railroad and Tax Commission, and later statistician with the Wisconsin State Railroad Commission. His exceptional ability, of a range beyond the needs of his previous activities, soon manifested itself after he joined the North American Company. At his death he was an officer or director of more than thirty corporations.

Mr. Gruhl was a son of Fred J. and Emma Shroeder Gruhl. He received his B.A. degree from the University of Wisconsin in 1908. In 1924 he married Helen E. Way of Milwaukee, who survives, as does his mother, a resident of Milwaukee.

MEMBERS ADDED SINCE DECEMBER, 1932

Badger, George F., Assistant Epidemiologist, Herman Kiefer Hospital, Detroit, Mich.

Benowitz, Hyman K., Analyst, 301 Greenwich Street, New York, N. Y.

Bowerman, Walter G., Assistant Actuary, New York Life Insurance Company, 51 Madison Avenue, New York, N. Y.

Carlton, Dr. Frank T., Case School of Applied Science, Cleveland, Ohio.

Dulles, Dr. Eleanor L., Instructor, University of Pennsylvania, 3440 Walnut Street, Philadelphia, Pa.

Ellison, Professor John M., Department of Sociology, Virginia State College, Ettrick, Va.

Fink, Hugh W., Department of Statistics, American Telephone and Telegraph Company, 195 Broadway, New York, N. Y.

Gerken, Theodore H., Resident Editor at Pittsburgh for the *Iron Age*, 1319 Park Building, Pittsburgh, Pa.

Hanchett, Dr. D. S., Fieldston School, Fieldston Road, Fieldston, N. Y.

Hobbs, G. Warfield, 3rd, Investment Department, City Bank Farmers Trust Company, 22 William Street, New York, N. Y.

Hutchinson, Edward P., Graduate Student, Department of Biology and Public Health, Massachusetts Institute of Technology, Cambridge, Mass.

Lupinski, Hugo H., Supervisor of Statistics, New York Telephone Company, 1775 Grand Concourse, Room 801, New York, N. Y.

Miller, Edward C., General Supervisor of Statistical Department, Near East Foundation, 151 Fifth Avenue, New York, N. Y.

Miller, Emory T., Statistical Research, Clinton Gilbert and Company, 120 Broadway, New York, N. Y.

Phelps, Gordon, Statistical Department, Ned. Koloniale Petroleum Mij., Soengei Gerong, Palembang, Sumatra, Netherland East Indies.

Roe, Frederick, Investment Management, 120 South La Salle Street, Chicago, Ill.

Riordan, John, American Telephone and Telegraph Company, 195 Broadway, New York, N. Y.

Schmidt, Dr. Carl T., Charleston College, Charleston, S. C.

Schumacher, Francis X., Section of Forest Measurements, U. S. Forest Service, Washington, D. C.

Schwarz, Ruth, Social Statistician, Emergency Home Relief Bureau, 69 West 47 Street, New York, N. Y.

Stahl, Gustav R., National Industrial Conference Board, Inc., 217 Park Avenue, New York, N. Y.

Timmerman, Willem A., Statistical Department, South African Railways and Harbours, 39, Plantation Road, Auckland Park, Johannesburg, South Africa.

Tufts, Mrs. Edith M., Research Associate, Bureau of Social Research, 711 Wabash Building, Pittsburgh, Pa.

Wilson, Robert L., Analyst, Bell Telephone Company of Pennsylvania, 416 Seventh Avenue, Pittsburgh, Pa.

REVIEWS

Economic Tendencies: Aspects of Pre-War and Post-War Changes, by Frederick C. Mills. New York: National Bureau of Economic Research. 1932. 625 pp.

Professor Mills' book traces the leading economic tendencies which characterized two periods in American history, 1901–1913 and 1922–1929. The work thus falls into two major parts: Chapters I–IV dealing with the earlier period and Chapters VI–IX with the later one. Chapter V summarizes briefly the interregnum from 1913 to 1922. For each of the two periods successive chapters deal with Production, Commodity Prices, Prices and Cost Changes in the Manufacturing Industries, and Other Economic Changes.

The tabular contrast between the two periods which begins the foreword is sufficiently striking to arouse interest. The first was a period of rising prices, the second of almost stationary prices. Per capita real earnings in manufacturing industries rose rapidly in the second period, but fell slightly in the first. The per capita volume of production increased more than twice as fast in the second period as in the first. The prices of common stocks rose eight times as fast in the second period as in the first.

The method of the book is primarily that of statistical description. The author is careful to explain that his "study does not aim at an explanation of the recession of 1929." But the book is not without hypotheses. The chief of these is the concept of stability. Obviously a changing society will alter in many ways: in the nature of the goods consumed, in the relative prices received for different classes of goods, etc. All these changes cause strain and stress. The book is devoted to these changes. "We may hope," says the author, "ultimately to define more accurately than is now possible the limits of tolerance of the existing order in relation to the stresses and strains to which it is exposed."

Since it would be impossible in the limits of a review to describe the contents of a book so large and so full of material, I have selected the first and sixth chapters which deal with Production in the two periods as illustrations of the author's method. Goods are divided into many different classes: raw materials and manufactured goods; farm products and all other goods; raw farm products and processed farm products; other raw products and other processed products; foods and non-foods; foods raw and foods processed; consumption goods and capital goods, etc. For each of these classes an index number of production, the annual rate of change and an index of instability are calculated. Some of these classifications and contrasts have important significance. For example, it is easy to see that with a population growing at the average rate of 2 per cent, an increase of raw American farm products at the rate of only 1.7 per cent would be favorable to the farmers. The farm population is relatively homogeneous. But what is the significance of a difference in the relative rates of growth of the production of processed foods and raw foods? This is to complain, however, of a superabundance of furnished material. The author might very well reply that at some later date importance in someone's theory might attach to just such a

distinction. Extremely interesting differences in the production movements of different classes of goods in the two periods emerge from the discussion. The two chapters on Commodity Prices follow in general the same classification as those on Production.

In the two chapters on Prices and Cost Changes in the Manufacturing Industries, the author has used the Census of Manufactures to compute some new and highly interesting figures as to changes in labor costs and overhead costs and profits. It appears that from 1899 to 1914 labor costs per unit of product (in terms of a commodity standard) declined 16 per cent and overhead costs plus profits declined 22 per cent. The per unit value (in a commodity standard) declined 6 per cent. During the period 1923–1929 strikingly different results appear: The value of manufactured goods (in terms of commodities) fell per unit 4 per cent. Labor costs fell 9 per cent and overhead costs plus profits rose 11 per cent.

The other sections of the book are done on an equally elaborate scale. It is not only that the author has discovered new points of attack on the problem of stability, but the statistical material available has been elaborated in a fashion never before equalled. For instance, in the section devoted to the growth of capital, there is the most successful attempt yet made to deal with the almost insuperable difficulties involved.

The author has produced an important book which will long be a source book for those who deal with that instability which is the curse of modern economic society. The National Bureau of Economic Research and the Committee on Recent Economic Changes deserve great credit for making its production possible.

George E. Barnett

The Johns Hopkins University

American Business Leaders, Study in Social Origins and Social Stratification, by F. W. Taussig and C. S. Joslyn. New York: The Macmillan Company. 1932. xiv, 319 pp.

The authors of this study have collected new evidences regarding the social origins of American business leaders. They defined business leaders as the partners or owners or higher executives of businesses having for the most part a volume of sales or gross income exceeding $500,000. They took reasonable pains to obtain an adequate sample of this class. They drew up a fairly skilful questionnaire (it could, we shall see, have been improved upon) and they got a surprisingly large response—8,749 replies out of a maximum of 15,101. They set up a competent statistical technique to deal with the resulting materials. And they found, among other things, that 30 per cent of the sample are the sons of fathers who belong to the same general category of "big" business men, that 50.7 per cent "are the sons of business men of one kind or another," while only 12.4 per cent are the sons of farmers, 5 per cent of clerks or salesmen, 8 per cent of skilled laborers and 2.2 per cent of unskilled laborers.

So far so good. While the authors regard their results as in conflict with a

prevailing tradition their figures are in accord with various other evidences, though they are more specific and conclusive. If the authors had stopped at this point, they would have added some significant new facts to our knowledge of the social derivation of business leaders. But, alas, these facts were only the starting-point of a more ambitious enquiry in which, strangely enough so far at least as the senior author is concerned, they proved lamentably inexpert. Their further objective was "to throw light, as far as possible, on the relative influence of hereditary and of environmental factors in causing such disparities as may exist between the representation of the several classes among business leaders and their representation in the population at large." (p. 3)

Here they enter with curious innocence into a difficult controversial field. The history of the attempt to discern and evaluate the respective rôles of hereditary and of environmental factors is full of salutary warnings, but the authors either do not know of them or have not taken them to heart. In their questionnaire they endeavor to evaluate environmental factors under four heads, influential connections, financial aid, general schooling, and formal business training. On the first two heads they ask these questions: (1) Were any of your relatives or friends interested, as owners or executives, (a) in the business which you first entered, (b) in your present organization when you entered it; and (2) Did you, during the early stages of your business career, receive substantial aid (not less than $10,000) through the provision of capital from either of the following sources (a) inheritance, (b) relatives or friends? These questions were put on the ground that "the environmental factors regarded as most essential in contributing towards success in business are two: capital and connections." Observe in passing that "the minimum amount of such aid to be considered significant was set at $10,000"! Observe also that, as the authors themselves acknowledge, if the term "friends" includes business acquaintances, probably most business men, appointed to a position of high responsibility, have friends among the owners or executives of the business in question. Only 20.6 of the sample gave, however, an affirmative answer to this part of the question.

As for the results, it transpired that only 11.6 per cent reported "substantial financial aid" from the two sources mentioned, that 35.9 per cent had "influential connections as that term is defined in the questionnaire," that 31.9 per cent were college graduates, and so forth. It also appears that "business leaders in the United States are today being recruited, to a substantially greater extent than was the case thirty or forty years ago, from among the sons of major executives." And then the authors claim that their evidences "strongly suggest, even if they do not prove, that lack of native ability rather than lack of opportunity is primarily responsible for the failure of the lower occupational classes to be as well represented as the higher classes."

This is one of the baldest *non sequiturs* which the reviewer has come across for a long time in any work purporting to be a scientific investigation. The conclusion is in no logical sense a result of their study, but a mere guess, no better than any other in respect of this most intricate and most fascinating problem. Supposing we find that on all counts only a minority of business leaders had the definite advantage of the four environmental factors listed by our authors, what

follows? Do these meager factors sum up the difference between the environment of the "higher classes" and the "lower occupational classes"? Has poverty no other limiting influence and a higher social position no other stimulation in respect of a business career? Lamely, at the very end, the authors admit that there are also imponderable factors which "lie beyond the scope of the quantitative method," but they dismiss them as relatively unimportant in determining the disparities involved. "The social environment of the wage-earning classes in the United States is by no means devoid of influences stimulating the youth to a life of achievement." "What is more, the way to success in business is made relatively easy for the American boy born of poor parents." Here the authors pull themselves up and add a footnote: "easy, that is, relative to the obstacles which must be overcome by a boy in Europe, born of parents in similar circumstances." Which, of course, has nothing to do with the case. And after a few remarks of similar tenor they blithely restate the "strong suggestion" to which "their results" point, that "inequality of earnings between the several occupational classes has its origins in a fundamental inequality of native endowments, rather than in an inequality of opportunities."

It should perhaps be noted that, while the date of the sending out of the questionnaires is not given, there is internal evidence that it was before 1929.

R. M. MacIver

Columbia University

International Unemployment, M. L. Fledderus, Editor. The Hague and New York: International Industrial Relations Institute. 1932. 496 pp.

This is the first of two volumes presenting reports made to the World Social Economic Congress, held under the auspices of the International Industrial Relations Association in August, 1931. This volume considers data with regard to unemployment in eight nations. The second will include an analysis of factors underlying world-wide unemployment together with conference discussions on World Social and Economic Planning.

The purpose of these investigations and reports is clearly described in an "Introduction and Summary" by Mary van Kleeck. They were undertaken to "give a picture of the recurrence of unemployment in different parts of the world during the two decades that have ended in the present depression," to note any evidences of international interrelationships affecting such conditions and to discover the major causes of unemployment in each nation. It is hoped that these studies may occasion more extensive and intensive investigations of a similar nature.

Data relating to (1) fluctuations in employment in each nation from 1910 to 1930, (2) changes in real wages and in living standards during the same period, and (3) related developments in economic resources and changed industrial productivity make up the major materials of these reports. The studies sought to discover particularly the dates of high and low points in unemployment, rather than detailed data as to the extent of these fluctuations in each nation, for it was recognized that international comparisons could be made only in the most general

terms, due to differences in the nature of statistics obtainable in the various nations.

Only brief attention can be given to the most notable contributions of each of the individual national surveys. Several of them are seriously limited by the fact that data for certain years are inaccurate or non-existent. The principal findings of the studies in each of the eight nations may, however, be summarized as follows:

Australia showed little unemployment in the years just preceding the World War. In the last quarter of 1914 and the first quarter of 1915, there was, however, more serious unemployment. During the remaining war years, employment was good, and in the boom years, 1919 and 1920, it improved further. In 1921, unemployment again became serious, but it was reduced immediately thereafter, and, excepting for a bad fourth quarter in 1924, it remained close to its pre-war average until 1928. Since that time it has become increasingly serious. Most important among the causes of unemployment in Australia is the economic distress of those nations that ordinarily purchase greatest quantities of her agricultural products, but importance attaches also to the difficulty of adjusting wage rates to lower commodity prices.

Employment conditions in Australia show a rather close correspondence to those featuring Great Britain. In the latter nation, unemployment was on the decline in the years 1910 to 1913. It was insignificant during the War. In 1919, post-war deflation began, and indices of unemployment rose rapidly as the severe depression of 1921–1922 appeared. Thereafter, until 1930, the percentages were generally somewhat lower, but they established a new and higher level of unemployment, compared to that of the pre-war period. In 1930 a new high record for unemployment was established.

Careful analysis of the industrial, geographic, sex, and age distributions of unemployment in England accompanies this statement of trends, and special attention is given to causes of post-war British unemployment. Particular responsibility attaches, in this connection, to the rigidity of wage rates enforced since the War.

France is distinctive, among the nations studied, for the almost total absence of unemployment in most of the post-war period up to 1930. Directly following the War and until 1923, the difficulty of finding jobs for veterans occasioned some unemployment, but cyclical fluctuations noted in England and Australia did not exert as great influence in France. The years 1923 to the end of 1930, with the exception of one year, 1927, represent a period with almost no unemployment, and, although numbers out of work increased in 1928 and 1929, they have not become comparable to those in England or Germany. Detailed consideration is given, in the study, to characteristics of France that assist in explaining this distinction, and particular significance is attached to the prevalence of reconstruction activities, to flexibility in wage rates, and to the monetary policy of the French government.

Data available in China do not permit a study of conditions in that nation that is at all comparable to those undertaken in the other seven countries. The analysis of "Industry and Labor in China" is actually a brief history of Chinese

industrial development and accompanying legislation. As such it is most interesting and valuable, but the propriety of its inclusion in this volume appears questionable.

The course of unemployment in Germany is somewhat similar to that noted in England. In pre-war years, the nation experienced rather drastic seasonal fluctuations, but cyclical unemployment was not extensive. Although large numbers were out of work in the first year of the War, unemployment during the remainder of the period was slight. After the War, from 1918 to 1923, unemployment remained insignificant largely because of the industrial activity occasioned by currency inflation. When currency was stabilized in 1924, this situation changed, and 1924 was a year of unusual unemployment. This was followed, however, by a return to pre-war levels in 1925, largely because of the Dawes Plan. In the latter portion of 1925 and in 1926, unemployment again rose. In 1927, however, it was reduced, by the stimulation of business resulting from foreign loans, to the lowest point in the post-war period. Thereafter, in 1928 and 1929, unemployment increased. In 1930 and 1931 it remained at a high level.

Lack of capital, reflected in very high interest rates, appears to have been most important among the causes of German unemployment in this period.

Canadian data with respect to unemployment, like those of the United States, must be drawn largely from trade union statistics, but such data are probably more accurate in the Dominion and they cover a longer time period. They present a sample, also, that has often included 70 to 80 per cent of all organized workers. Unemployment was not serious in the years just preceding the depression of 1914 in Canada, and although it increased in 1914 and 1915, it was slight in the following years from 1916 to 1918. It rose in 1919 and the second half of 1920 and remained high throughout 1921. It fell in 1922 and 1923, rose in 1924, and then fell to very low levels until 1929. It rose rapidly in 1929 and continued this rise throughout 1930. Causes of unemployment appear to be similar to those noted in Australia, although labor conditions were less important in Canada.

In the discussion of employment conditions in the United States, data indicating long-time changes are restricted to factory and railroad workers. Short-time comparisons are made upon the basis of samples secured in recent years. From these data it appears that maximum industrial employment was reached in 1918, and that there was increasing unemployment throughout 1921, 1922, and 1923. Thereafter, until 1929, employment conditions improved, but they did not reach the 1918 level. Unemployment increased rapidly after October, 1929, and had not been reduced at the time this study was completed. Little attention is given to the relative importance of various causes of unemployment.

The section given over to Employment and Unemployment in Pre-War and Soviet Russia indicates that industrial employment declined rapidly in Russia from 1913 to 1923–1924, although unemployment appears to have attracted little attention and to have escaped tabulation until it rose, in 1923–1924, to more than a million. It remained at about that level until 1929, when it almost doubled. Thereafter, a striking decrease in unemployment is noted throughout

the year 1930. The study closes with the observation that practically the only remaining unemployment is that of young people seeking to begin work and adults desiring to shift vocations. Unemployment insurance funds are now being used to adapt these applicants for places in the industrial system, rather than for the payment of insurance benefits, for the latter have become unnecessary.

Meanwhile, production and worker productivity have been greatly increased, and average real wages have risen markedly.

Two conclusions are expressed in the summary. The studies show that unemployment is, in a considerable measure, an international phenomenon, both in its causes and in its effects. Close correlation in employment fluctuations is discernible among nations having important trade relationships. It is suggested that these investigations indicate further that nationalism and fear for national security, by preventing effective economic coöperation, are most responsible for the disturbance of that equilibrium in production essential to general prosperity and minimum unemployment in all nations.

The volume represents much careful work. It is of real value as a reference, and encourages expectant anticipation of its companion study on economic planning. It indicates emphatically the present poverty of inclusive employment statistics and the necessity for more careful collection and analysis of such data.

Dale Yoder

State University of Iowa

Agricultural Russia and the Wheat Problem, by Vladimir P. Timoshenko. Stanford University, California: Published jointly by the Food Research Institute and the Committee of the Hoover War Library. 1932. 470 pp.

This volume is of great importance not only to those who are interested in economic conditions in Soviet Russia, but as well to economists and statisticians who have to deal with the problem of world demand and supply of wheat. In most current estimates of the international statistical position of wheat it is customary to refer to world production "exclusive of Russia." In large measure this has been due to the reluctance of statisticians to essay the task of interpreting Soviet statistics. All specialists in this field have wondered whether or not the pre-war statistics of grain production and of sown area are comparable with those compiled by Soviet statisticians at the present time. Dr. Timoshenko has performed the service of analyzing the data and comes to the conclusion that Soviet statistics of grain production are comparable with pre-war statistics only if the pre-war estimates are increased by 19 per cent. He believes, however, that the pre-war statistics did not underestimate crop production and that consequently Soviet statistics must overestimate grain production.

Timoshenko's book is a mine of information in respect to all aspects and details of Russian agriculture, but his particular purpose is to analyze the probable future of Russian wheat exports. He disposes of the popular legend about the unlimited expansibility of crop area by explaining the limitations of temperature

and rainfall which render such a large proportion of the area of Russia unfit for cultivation. He explains that the areas which are suitable for cultivation are already well populated and calls attention to the rate of increase in population which reduces the possibilities for grain exports. He estimates that in order to provide the same per capita consumption of bread grains as during pre-war times and to reach the pre-war level of exports it would be necessary to increase the present sown area by some twenty per cent and to provide an additional two per cent yearly increase in production to take care of further population increase. He does not believe, therefore, that the resumption of grain exports upon the pre-war scale is to be counted upon under existing circumstances.

CALVIN B. HOOVER

Duke University

The Fiscal Problem in Massachusetts. New York: National Industrial Conference Board. 1931. xv, 311 pp.

This study aims at an objective description of the state and local system of revenues and expenditures in Massachusetts. The preface disavows any intention of recommending or advocating specific proposals, but this attitude does not prevent some fairly definite expressions of preference in a chapter dealing with possible adjustments in the revenue system.

As a purely descriptive undertaking, the result is fairly satisfactory; but it is subject to the shortcomings necessarily incurred by such a self-imposed limitation of scope. The Conference Board apparently refrains from demanding of its staff the insight, judgment and wisdom that would be required to infuse vitality and meaning into its compilations of data. Consequently the result does not rise above the level of a handbook or compendium of information regarding state and local finances in Massachusetts.

The opening chapter, on state and local expenditures, illustrates the point. It is a useful compilation of expenditure data and trends for the state, the counties, and the cities and towns. This task was relatively easy for Massachusetts, and the results were the more reliable, on account of the comprehensive annual statistical reports on local finances issued by the state.

It is unfortunate that even so much of comparative analysis of such data as is given here had to wait for an outside agency. The reviewer has long held that governmental statisticians have not yet learned the A B C of proper statistical use. The enormous possibilities of informing and educating the people as to what government is and does are almost wholly neglected in official reports. Professional statisticians could achieve no greater triumph than that of inaugurating a movement to cut the dust out of government statistics and make them the basis of a vital, human story of governmental business.

The chapter on expenditures in this study lacks the divine spark. It is designed as a keynote to the whole undertaking. It goes through the motions of explaining why taxes have increased and why Massachusetts has a problem of fiscal readjustment, but after all the careful tabulation of the facts, it emerges from the self-same door wherein it went—public expenditures have increased.

There is no recognition of the vital problem of functional allocation. County expenditures are tabulated, but the possibilities of the county as an administrative unit are not considered. The county is traditionally weak in Massachusetts. What of it? When backs are breaking under tax burdens, there is need of a courageous examination of every possibility that may secure lower costs. The devotees of the baked bean, the cod and the town meeting may not like the answer, but some one needs to find out for Massachusetts, where the several governmental functions can best be performed. The important experiment with metropolitan districts in Massachusetts is not touched upon, although it affords opportunity for an immensely important contribution to the fundamental problem of administrative efficiency.

The chapters dealing with the revenue system cover well-known ground, without contributing to what was already known of the situation. A final chapter indicates that expenditure control is essential, but goes no further than brief reference to the schemes operating in Indiana and North Carolina. The control of expenditures is the heart of the fiscal problem, in Massachusetts and every other state, but this control involves matters of administrative organization and financial policy that are not dealt with at all in this study.

H. L. Lutz

Princeton University

Balances of Payments, 1930 (including an Analysis of Capital Movements in 1931). Geneva: Publications Department of the League of Nations. 1932. 183 pp.

This is Volume II of an annual series of publications by the League. Volumes I and III are, respectively, "Review of World Trade, 1930" and "International Trade Statistics, 1930." It is of special value to Americans, because the United States Department of Commerce regularly issues, at lower prices, virtually all the data contained in Volumes I and III; whereas no other serial publication in the world summarizes the balances of international payments of all countries compiling them. The publication is obtainable at the World Peace Foundation, 40 Mt. Vernon Street, Boston, Massachusetts.

This latest annual issue contains further striking evidence of the rapidly growing interest in balances of international payments, the world over. It summarizes the surveys of no less than 32 countries. The corresponding publication by the League for 1923 covered only 10 countries. Going back a decade earlier, I am fond of the confession that—after majoring in the theory of international trade during two years of graduate work at Columbia University—I escaped as oblivious to the existence of this statistical species as was Adam Smith. The term "balance of payments" had been used as early as 1810, as Miss Cleona Lewis proves in her treatise on the International Accounts; yet, as late as 1914, one would philosophize profoundly about the relationship of visibles and invisibles in foreign trade without realizing that anyone "had a name for it."

The present compendium brings into the fold such welcome strangers as Albania, Bulgaria, Paraguay and New Zealand. Presumably their balances of payments will appear annually hereafter, in steadily improving detail and pre-

cision. Surinam, Dutch East Indies, and the Irish Free State are among countries previously reporting. Curiously enough, only a few of the ten foremost trading or lending nations have thus far compiled their balances of payments with such scholarly method as certain relatively small nations like Hungary, Czechoslovakia and Yugoslavia. France, for example, issues no official balance of payments at all. England still clings to its antiquarian, "two-cylinder" report, which sometimes goes to press a fortnight or so after the year-end. Yet, it is from this British prototype that all the others have been evolved during the past two decades.

The League always presents balances of payments in a standardized "account" form, rather than in varying "report" forms. That I have always regarded as a defect. In account form, they make duller reading. Besides, their uniformity suggests a degree of comparability that does not exist. The standardized form seems too inelastic to fit the varying conditions and problems of all countries, and it impedes progress in presentation. Premature standardization, in a pioneer field like this, might well have been avoided.

This League publication, together with others of its series, greatly facilitates a study of business cycles from what is relatively a new angle. In our last world depression (approximately 1919 to 1921) data hardly existed for a separate study of the international aspects of the cycle. A sturdy beginning of such a study, of the present world depression, is contained in the 36 pages devoted to "A Summary Statement Concerning Certain Items." I refer especially to the admirable discussions on:

(a) Capital balance and its relation to merchandise and gold movements.
(b) Capital movements and relative prices.
(c) United States capital and gold movement.
(d) Long- and short-term capital operations in 1930 and 1931.

Nowhere, I think, is there a more succinct story of how world business was thrown out of gear by the reckless inflation and ruthless deflation of the capital-importing nations by capital-exporting nations. America's large share of responsibility for that masterpiece of destructiveness, by the way, is too often denied.

The compendium gives, perhaps properly, more space to the balances of payments of America, England and Germany than to most of the others. The American survey, as published by the Department of Commerce, is still the richest source-book in methodology, being 40,000 to 50,000 words long. In summarizing that publication, the League neglected to point out that the net export of capital by the United States in 1930 was estimated by a different method and hence is not comparable with the figures for earlier years. That much of the public controversy in this country, over our 1930 balance of payments, could have been mentioned by the League editors, without taking sides in a dispute that still rages.

RAY OVID HALL

The Banking Situation in the United States. New York: National Industrial Conference Board. 1932. xiv, 157 pp.

This study, prepared by Ralph A. Young and assistants, will be extremely useful both to business men and to teachers. It is the only volume published to date which undertakes to bring together in brief compass all the main statistical facts in the history of the American banking system since the War. This task it performs well. The main lines of the exposition are intelligently organized, and the reader is left with as compact a picture as the subject matter itself will permit.

The principal facts and changes with which the book deals are already familiar to students in the field. They are, in chief, the remarkable post-war growth of deposits; the persistent shift of deposits from the demand to the time category, with its resulting decrease in aggregate effective reserve requirements and increase in the vulnerability of the banking system to initial shocks; the changing structure of the system itself, due to failures, mergers, and the growth of branches and chains; the shift in the character of bank assets, with a falling proportion of commercial documents and other commercial claims and a rising proportion of securities and mortgages; the change in the character of business requirements for bank credit which this shift reflects; the inability of access to Federal Reserve system resources to prevent, in itself alone, appallingly numerous bank failures; and the drastic readjustments in the structure of American bank credit as a whole which severe business depression, under these conditions, has almost inevitably produced. The principal facts under these heads are brought out clearly. The general reliance on percentages to indicate the importance of changes, rather than on logarithmic charts, does not here introduce serious distortions (unless in connection with surplus reserves, as on page 130). The critic may cavil somewhat at the discussions and tests of "liquidity," or at least desire that the analysis had been pushed farther (pp. 76–81, 94 ff., 105, 108, 125 ff.) but the matter is not vital to the general purposes of the book.

The discussions of the real meaning of what has taken place, however, and of what should be done to strengthen the banking system in the future, is rather less satisfactory. It is suggested that the unification of legislative and administrative control under the Federal Government is desirable, and also an expansion of the branch and chain systems — this last, of course, in order to reduce the number of small, inefficient, weak unit banks. With these suggestions we may agree. But to the present reviewer, it does not seem that such proposals go to the heart of the matter. The great fact about our banking system which the present depression has revealed is that, to a degree we have never before equalled, we have had far too much banking, and far too large a volume of bank deposits. In the face of what we now see to have been such marked over-expansion, it may be doubted if any banking system at all could have remained unimpaired, or perhaps even solvent; in the face of such over-expansion, the traditional canons of "liquidity" and "shiftability" — which themselves are only relative at best — may become almost valueless as guides to practical banking policy. The power to create additional bank deposits, additional media of exchange, is one of the

most potentially dangerous powers in the economic world. It is this power, now restricted only in terms of the maintenance of minimum reserve ratios, which itself supremely requires to be guarded and controlled in absolute terms as well. Until such control is secured, no forms of legal and operative organization can assuredly safeguard the banking system and the country's general economic life.

James W. Angell

Columbia University

Die Wirtschaftlichen Zeitreihen als Problem der Korrelationsrechnung, by Herman v. Schelling. Veröffentlichungen der Frankfurter Gesellschaft für Konjunkturforschung, herausgegeben von Dr. Eugen Altschul. Heft 11. Bonn: Verlag von Kurt Schroeder. 1931. 64 pp.

The Frankfurter Society for the study of conjuncture continues its series of interesting publications on the problems of the analysis of time series, particularly of their correlation. In one of the previous issues (Heft 4, *Die Korrelationsrechnung in der Konjunkturforschung*) Oskar Anderson developed a complete theory of the variate-difference-method. In the present publication, v. Schelling considers time series correlation with special reference to the "lag" problem, basing his analysis on the earlier study by Anderson. He shares with Anderson his scepticism of the method of breaking down time series into their component elements—such as trend, seasonal fluctuations and cycles—so popular in this country. He thinks that the different ways of eliminating a trend (particularly by some form of mathematical curve) may so affect the measure of correlation that it is hardly possible to have much confidence in it. The author holds that there is no strict measure of correlation of general significance (allgemeingültig) for any empirical data. He qualifies his scepticism, however, by pointing out that when empirical data are duly arranged and several or many coefficients of correlation, comparable one with another, are obtained, conclusions may be drawn from their relative values.

In developing his positive contributions, the author emphasizes the necessity of computing many coefficients of correlation, shifting the two series one along the other, and analyzing the relative values of all such coefficients. The totality of these coefficients rather than the separate coefficients is indicative of the degree of association. He tries to show (in a mathematical appendix) that while the absolute values of the coefficients may be substantially affected by an incorrect breakdown of the variables into their component elements (for instance by an incorrect determination of the trend values) and for this reason the individual coefficients cannot be relied upon as a measure of association, the *relative* values of several coefficients calculated for two series shifted one along the other, retain, under certain conditions, their true proportions and are comparable. An analysis of the relative values of several such coefficients is thus used not only for determining the time "lag," which is a general practice, but also for determining the "direction" of the relationship: which of the two factors may be considered as a cause and which as a consequence, whether there is a mutual influence of factors one upon another, and what is their relative importance. Although

sceptical of the possibility of extrapolating time series in general, v. Schelling indicates a procedure by which such extrapolation for a short period may be done with some degree of reliability, using for this purpose, a detailed study of serial correlations (using the term of Yule).

To reduce the amount of computation v. Schelling develops, in the third chapter, graphic methods for determining the coefficient of correlation, especially adapted to the correlation of series shifted one along the other. He claims that his method requires much simpler and cheaper implements than the automatic correlation calculating machine of C. L. Hull.

The problem studied by v. Schelling is of great importance. In the correlation of time series on the relationship between crop prices and yields (or total production) it has proved to be most valuable to have several coefficients computed from the series of prices and of yields shifted one along the other. For this a theoretical analysis of the problem in a general form is welcome. It is only to be regretted that v. Schelling's analysis is sometimes sketchy and not always clear. The fact that mathematical proofs are removed to mathematical appendix does not make the reading of the text easy for persons not specially trained in mathematics. An illustration of the method by solution of a few concrete problems would facilitate the reader's understanding.

V. P. TIMOSHENKO

University of Michigan

Review of World Production, 1925–1931. Geneva: League of Nations, Economic and Financial Organization. 1932. 166 pp. (American Agent, World Peace Foundation, Boston, Massachusetts.)

In the latest review of world production by the League's Economic and Financial Section more attention is given than in earlier issues to the course of industrial production and of prices, with particular emphasis on the varying severity of the depression of 1930–1931 on different continents and in different industries. A significant new feature is an analysis of the incidence of price declines on consumers' as opposed to producers' goods and on industrial as opposed to agricultural raw materials. The period covered in this edition—1925 to 1931—offers a contrast between the expansion of production in the years 1925–1929 and the depression of the years 1930–1931, and is an invaluable background for observation of current economic developments. The *Review* gains in perspective what it loses in timeliness by reason of the fact that the data on which the studies are based are with few exceptions annual rather than monthly, and the most recent figures are for 1931.

The methods used in constructing the indices presented in the *Memorandum* have not been altered materially from those established in earlier editions. The base period has again been shifted, this time to the average for the period 1925–1929, and while the advantages of the quinquennium as compared with a single-year base are obvious, one wishes that the base period might remain unchanged for at least two years in succession for the benefit of those who make considerable

use of the indices, and who find it inconvenient annually to revise both their memories and their charts.

ARYNESS JOY

Division of Research and Statistics,
Federal Reserve Board

Disability Benefits in Life Insurance Policies, by Arthur Hunter and James T. Phillips. New York: The Actuarial Society of America. 1932. ix, 252 pp.

Restricted disability benefits were introduced into life insurance contracts in the United States in 1896. The competitive value of such benefits led to their adoption by most companies, and to the gradual liberalization both of contract provisions and of administrative interpretation. Premiums have proved inadequate, and the companies, involved in serious loss on account of this business, have now reversed their attitude. Disability clauses have been either discontinued or restricted, and where continued have been much less freely issued.

The appearance of the present volume is most timely. The authors, one of whom, Dr. Hunter, has been closely identified with the development of this business from its inception, have brought together the essential information on the history and present status of the problem.

Part I is devoted to the development of disability benefits and to the business and legal problems to which they have given rise. It is a brief text on the principles and practices of this branch of the life insurance business. Part II deals with the statistical and actuarial phases of disability insurance: experience, mortality and disability tables, annuities, premiums, and reserves. It is a complete technical explanation by highly qualified technicians.

In addition to the textual material the Appendices contain a collection of forms, the proposed standard provisions of 1929, definitions of actuarial symbols, and a valuable bibliography.

Whether one's interest in the development of disability benefits be general, technical, or both, this book may be relied upon as an up-to-date authoritative treatment of the subject.

RALPH H. BLANCHARD

Columbia University

The New York Money Market, by Margaret G. Myers. New York: Columbia University Press. 1931. xv, 470 pp.

This is the first volume of a comprehensive study of the New York money market prepared under the auspices of the Council for Research in the Social Sciences of Columbia University. It covers the period from the time of the Revolution to the adoption of the Federal Reserve Act. A subsequent volume by Benjamin H. Beckhart, James G. Smith and William A. Brown will cover the Federal Reserve period to date.

Miss Myers has wisely avoided a narrow monographical treatment. The money market is an interdependent whole and none of its institutions can fruit-

fully be examined in isolation from the complex structure of which it is a part. The author adopts Bagehot's phrase "borrowed funds" as the limiting concept thus including "all the funds available for productive, commercial and speculative purposes, as well as the mechanism by which these funds are gathered from holders not immediately requiring their use, and redistributed in answer to the needs of various classes of borrowers." She avoids the usual disadvantages of the more conventional historical treatment by a happy topical arrangement with summarizing chronological chapters. The review chapters X and XIX can be recommended to those who lack time or interest for the topical treatment.

The money market is obviously not a subject for isolated study. Miss Myers has placed it in a broad framework of national economic and political development, Treasury policies and other related factors. The chapters on foreign credits and the independent treasury are good examples of this and would be much weaker if artificial limitation of subject matter had been preferred. This choice of a more comprehensive treatment is all the more justified since this is the *first full historical treatment of the New York money market.*

The author has given a competent and very readable account of her subject. The reviewer can vouch for its value as a reference work from his experience with it during the period in which it awaited more systematic attention. The Columbia University Press is to be congratulated for its handsome treatment of both text and illustrations.

HARRY D. GIDEONSE

University of Chicago

Preferred Stocks as Long-Term Investments, by R. G. Rodkey. Ann Arbor: The University of Michigan. 1932. 304 pp.

This study "is concerned primarily with the investment qualities of preferred stocks on an absolute basis. Of secondary importance are the comparisons made herein with bonds and common stocks of identical companies." In the last few years many students have approached the examination of securities with the same viewpoint. But is it possible to determine the investment qualities of stocks or bonds "on an absolute basis"? Qualities are relative, not absolute. The much-used hypothetical-investor tests, which Mr. Rodkey employed, do not reveal the "true nature" of securities. Such calculations show for the past the superiority of one investment plan over another. Their value lies in the fact that an individual with a knowledge of the results, bearing in mind his own requirements, and guessing at the similarity of the future with the past, is able to formulate a more intelligent investment policy.

In each of Mr. Rodkey's tests, equal sums were assumed to have been invested in the common and the preferred stocks, and in some cases the bonds, of ten identical companies. The period covered in most of the calculations was January, 1908, to January, 1932, two dates of deflated security values. The companies selected were those for which there were recorded the largest volumes of common (in one test, preferred) stock transactions during the year immediately preceding the date of purchase. The common stock investments in every test gave results

superior to the preferred both as to average annual yield and as to capital appreciation. The preferred stocks however, showed comparatively good results on both of these counts when only those stocks which were not preceded by bonds were held. Furthermore, the market value of these same preferred stocks fluctuated less violently than the common. When preferred stocks were compared with bonds, the average annual income and the capital gain for the twenty-four year period were greater in the case of preferred stocks.

The securities of identical companies were used because "changes in the credit conditions within the various companies presumably would thus find reflection in the prices of all lists." For comparative purposes, additional tests should have been run without this restriction. It is doubtful that an investor weighs the common stock of a company against the preferred of that same concern.

What is the justification for selecting stocks for investment on the basis of the volume of transactions in a certain type of security for a given time interval? Surely such technique does not give a sample chosen at random—and apparently that was wanted. If an effort is to be made to eliminate the factor of human judgment, why not pick the securities by lot? The results of such procedure would be very interesting—particularly, if to random selection for purchase, there was added the sale at regular intervals of one or more securities chosen at random from the investor's portfolio. It is not expected that such tests will reveal the "absolute qualities" of preferred stock or other securities, but the results could be compared with those obtained through various investment plans. Thus we would get some indication of the value of human judgment in investment.

Most investigators who run such tests as those described in this study assume that the hypothetical investor purchases ten securities—either because ten is ten or because an investor can be expected to watch only ten. Mr. Rodkey made an effort to prevent criticism on this point. First, the number of companies with common and preferred stocks, or with common and preferred stocks and bonds, was small in 1907, so that ten formed a large per cent of the whole. But, it might be asked, was the total large enough to yield valuable results? In the second place, Mr. Rodkey protected himself by making some supplementary tests which began with 1921 when selection was not confined to a small number of companies. In these tests substantially the same results were obtained as in those which began with 1918. Other individuals making similar studies would do well to check the size of a sample in some such way—or better, make tests with samples of various sizes.

In view of the small amount of work which has been done upon preferred stock, it seems advisable to consider one of Mr. Rodkey's assumptions, namely, that the conservative low-yield preferred stock is superior to the risky high-yield one. Under certain conditions this may be so, but some supporting data are necessary. An examination of Mr. Rodkey's fifth and sixth tests, which were identical in procedure except for a slight difference in the method of selection, produced some interesting material. The sixth, which showed both a larger average annual income and a larger capital gain, started with the purchase of stocks having an average (median) yield of 9.50 per cent, while the parallel figure for the fifth test

was 8.08 per cent. Among the original preferred stocks of the sixth test there was one upon which nothing had been paid in the year preceding purchase and there were five upon which full dividends had been paid for at least eight years; in the fifth test none of the first type was found and seven of the second appeared. Furthermore, one of the three preferred stocks which were retained throughout Test 6 was purchased at a price which yielded 12.3 per cent and produced a profit of $660.77. In contrast, another, purchased on a 7.7 per cent basis, showed a loss of $712.03. Finally, in the sixth test the maximum capital gain procured from a single original preferred stock purchase was received on the stock which had not paid anything in the year preceding acquisition. Of course, the evidence presented here merely suggests that the high-yield preferred stock cannot be lightly dismissed from consideration.

It seems to me that in valuing this and similar studies, we must remember that they may not—perhaps cannot—reveal the true nature of securities. Conclusions when examined from this viewpoint rarely seem justified by the material presented, though the tests themselves may be interesting and helpful. General statements—such as, preferred stocks which are senior securities fluctuate in market value less than common stocks and thus investment in these tends definitely to minimize the time hazard—should be properly modified. Would it not be possible to take the same or a different period, pick common stocks in one way and preferred in another, and get a contradictory result? If my query is subjected to the criticism: "You would use different periods or different methods for picking the stocks"—my answer is: "Just so. And you by your comment have admitted that this study shows only what particular tests will yield and not the qualities of preferred stock on an absolute basis."

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Recent Technological Changes and the Municipally Owned Power Plant, by Paul Jerome Raver. Chicago: The Institute for Economic Research. 1932. 86 pp.

To five previously published monographs on the historical and legal aspects of public enterprise in the power field, the Institute of Economics, affiliated with Northwestern University, has now added an excellent, though limited, analysis by Professor Paul Jerome Raver of the influence of technological factors upon the number, character, distribution, and fortunes of municipal generating enterprises. Professor Raver's data include every instance of municipal ownership between 1903 and 1930; his treatment, accompanied by unusually complete statistical tables, is lucid and painstakingly fair. After reviewing the rise, mortalities, and survivals of municipal plants in terms of prime movers, generating capacity, and regional differences, Professor Raver concludes that the growing resistance of municipal plants to further absorption by private enterprise is due to the establishment of a competitively successful "plateau of growth," composed of plants of more than 500 horsepower; and he predicts that most of

the remaining municipal plants will continue to grow and will become important keys in regional and national power plans.

The bare statistical facts of the relative growth of public and private enterprise in the electric light and power industry lend themselves easily to biased and contradictory interpretations. Opponents of public ownership are able to point to the fact that by the end of 1930, more than two-thirds of all the municipally owned generating plants that had been in operation at any time since 1903 had been sold to private interests or had substituted the purchase of power from the latter for municipal generation. Supporters of public ownership, on the other hand, are able to say that the installed horsepower capacity under municipal ownership at the end of 1930 was twelve times as great as it had been in 1904, and that more than one-half of this growth has taken place during the last decade. But there has been no real race between public and private capital in the electric power field. The distribution and scope of public ownership have been seriously limited by constitutional and statutory law. Where the law has not effectively barred public enterprise, it has largely restricted it to *municipal* political units operating under fixed constitutional debt-incurring possibilities and under charters that obstruct inter-municipal coöperation. The effects of technological developments upon the character and extent of public enterprise, discussed in the present monograph, are to be attributed in important measure to these legal barriers.

The majority of small municipal plants were started because private initiative was slow in supplying the needs of small communities. When, after 1917, enormous improvements in large-scale generating and transmission equipment encouraged the spread of transmission lines over large areas, hundreds of such plants were sold to private enterprises and abandoned, or were converted into municipally owned distributing stations. This took place not because of any weakness in public ownership as such, but because the small isolated plant, whether publicly or privately owned, could no longer generate electricity as cheaply as it could be delivered over transmission lines from large central stations. Thus, the decrease in the number of privately owned generating plants engaged in the sale of power was just as striking as that of municipal plants: the Census of Electrical Industries (U. S. Bureau of the Census) shows a drop in their numbers from 3,347 to 1,218 between 1917 and 1927 alone, a decrease of approximately 64 per cent. *Small* isolated plants, both publicly and privately owned, are still fairly numerous, but they are to be found chiefly in communities distant from transmission lines, or, as in the Southwest, where oil engines may tap a cheap source of power.

Wherever municipal operation has been conducted in communities large enough to employ large-scale steam turbine or hydro-electric equipment, it appears to have thrived vigorously and to have shown little tendency to surrender to private enterprise. Of the twelve-fold expansion in municipal generating capacity between 1904 and 1930, 85.5 per cent was the result of internal growth; and in the period of most rapid expansion, 1922 to 1930, the largest plants grew most, the 20 largest contributing 45 per cent of the aggregate internal growth. Despite the large *number* of plants deserting the municipal fold, the resultant *gross* loss in generating capacity was only 13.5 per cent of the accumulated total

generating capacity under municipal ownership at any time between 1904 and 1930.

These facts indicate that public enterprise in the power field has proved practicable on a municipal scale in communities large enough to employ modern generating apparatus. They do not, by themselves, throw light on the relative merits of public versus private ownership. The ability of moderate- and large-sized municipal establishments to compete successfully with interconnected generating and transmission systems of private enterprise may be matched by the similar success of isolated privately owned plants operating under similar conditions. The explanation in both cases is the same.

*Transmission systems are load-gathering devices that make possible larger-*scale generation and its economies. The range of such economies is not unlimited, however; and this range is narrowed, in effect, after generating efficiency has reached a certain point, by the line losses, maintenance expense, and capital charges of extensive transmission systems. Isolated plants operating in densely populated or great power-using industrial regions may achieve high generating efficiency without the burdens of extensive transmission lines.

The deficiencies of Professor Raver's study relate chiefly to its restricted character. No attempt is made to translate technological considerations into terms of pecuniary costs and pecuniary returns. No measure is given of the differences in rates that induced many communities to abandon municipal generation of power; of the comparative costs and rates of public and private enterprises employing the same or different types and sizes of generating equipment; the question of managerial competence is barely mentioned. The final facts of mortalities, survivals, and growth, which have been significantly influenced by various other factors, are thus elliptically correlated with qualitative technological considerations.

Like the preceding studies of the Institute, the present monograph is designed to provide indisputable factual material for use in the controversy between advocates of public and private enterprise (cf. Preface). Within its rather severely restricted scope, it does this in excellent fashion. To impinge upon some of the really crucial issues, however, it needs to be generously supplemented by studies in terms of costs, rates, and service; including, particularly, an important group of case studies of the capital costs, operating costs, and rates of comparable public and private enterprises.

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AN INTERNATIONAL INQUIRY INTO COSTS OF LIVING: A COMPARATIVE STUDY OF WORKERS' LIVING COSTS IN DETROIT AND FOURTEEN EUROPEAN CITIES [1]

By Leifur Magnusson

In 1929 the representative of the Ford Motor Company in London approached the International Labor Office at Geneva, Switzerland, and requested an answer to this specific question: How much must the branch factories in the various cities of Europe pay their European employees in order that they (the European employees) may enjoy the same standard of living as the workers of that same Company do on their Detroit wage? How much would those European employees have to expend if their general standard of consumption were to be approximately equivalent to that of the Detroit worker?

Note that the question was not asked: How much would it cost the Detroit worker to live in the European cities in the same manner as he does in Detroit; it was not a question of transferring the American worker from his environment and providing for him at European prices everything he consumed in Detroit; neither was it the reverse problem of finding the American price of what the European automobile worker consumes as his standard of living. The problem lay somewhere in between these two extremes, and consisted of maintaining the European worker in his customary way of living in a manner which would give him the same amount of satisfaction as the Detroit worker secured from his $7 a day.

As a problem in index numbers it was one of making a comparison of the standard of consumption in the European cities, that were ultimately selected for the inquiry, with the Detroit standard of consumption as a base.

[1] This paper is a revision of an earlier presentation given at the Ninety-fourth Annual Meeting of the American Statistical Association on December 29, 1932. It is based on the study of the International Labor Office entitled "A Contribution to the Study of International Comparisons of Costs of Living." (Studies and Reports, Series N, No. 17, 1932.)

A standard of living represents a quantity of material comforts enjoyed or utilized by any given member of society. It stands for a total of satisfactions derived from the utilization of material income. The satisfaction arises from the consumption of the economic goods and services that go to make up the standard. The enjoyment of the standard is something qualitative. It is measurable, however, only in objective terms, such as the amount of food consumed, the quantity of housing space, the consumption of fuel and light, and amount of clothing in number of articles. The standard of living is, therefore, expressed in the economic goods which the individual chooses and in which he manifests his satisfaction. As a measurable thing, then, the standard of living is a standard of consumption of economic goods and services selected and consumed by the individual making those choices.

It is quite clear that different choices will be made by different individuals according to the cultural environment in which they find themselves. Individuals will naturally be influenced by such variables as climate, divergent composition of population, and social environment, whether urban or rural, large city or small community. There are likely to be great divergencies as to the specific amounts, for example, of different foods consumed, beef as against mutton, meat as against fish, etc.; but when all these are combined in the single item of food such differentiations tend to disappear. This is so because with an increase in the number of items of choice the more uniform and homogeneous does the average become.

Again, it is evident that, if the problem were to compare the standard of living of individuals living in a fairly similar environment, it would become relatively simple and the more truthful would be the statement of the problem in terms of abstract index numbers.

The raw materials for answering the specific question as to differences in the cost of living of automobile workers in Detroit and similar workers in the fourteen European cities finally chosen for the inquiry are derived from four sources: (1) amounts of consumption of various items making up the standard of living of Detroit workers; (2) the money valuations of those items; (3) the unit prices of the different items of consumption of the Detroit workers in the currencies of the fourteen European cities; and (4) the amount of consumption of the different items that make up the European workers' standard of living.

The Detroit study supplied the raw material of the standard of living of the workers in that city. It was undertaken by the U. S. Bureau of Labor Statistics in consultation with experts of the International Labor Office and was made in February, 1930. It covered the year 1929. One hundred families, the heads of which received the lowest wage

scale of 1929 (that rate was then $6.00 a day and subsequently became $7.00 a day) were selected as an adequate sample. As nearly as possible the families were to be what might be termed typical statistical families—man, and wife and not over three children, and without boarders or dependents. The heads of these families were supposed to have had at least 225 days of work in 1929. The subsequent survey revealed that these families spent in 1929 an average of $1,720. (This was ultimately adjusted to the income of such families in 1931 to correspond with the period to which the studies in Europe relate.)

The agents of the U. S. Bureau of Labor Statistics secured by first-hand inquiry at the homes the actual budgets of the one hundred families selected. The questionnaires used contained 480 items and were filled in by interview with the housewife. The head of the family was interviewed to ascertain the income.

As a final outcome of the investigation by the Bureau of Labor Statistics, it appeared that the average daily income was $6.70, making an average year's earnings in 1929 of $1,694.63. Plus income from other sources the gross income was $1,711.87. The average expenditure of the one hundred families was slightly more, namely, $1,719.83, leaving an actual deficit per family of $7.96. The average size of the family was 4.5 persons which was reduced to "equivalent adult males" of 3.27.

The inquiry was then transferred to Europe and to the hands of the International Labor Office personnel and the labor and statistical departments of the different governments concerned. The cities to be covered included Berlin, Frankfurt-am-Main, Copenhagen, Stockholm, Helsinki (Helsingfors), Paris, Marseilles, Antwerp, Rotterdam, Manchester, Cork, Warsaw, Barcelona, Istanbul.

The itemized detail of the Detroit budget was slightly abbreviated and classified to conform to the known situation in the European cities. It was now circulated with instructions in the different countries and prices secured in European currencies in the fourteen cities covered. Where possible actual samples of Detroit clothing, household linen, etc., were used for purposes of comparison in identifying similar qualities and kinds of articles that make up household consumption. Agents of the national departments of labor and statistics with whom the representatives of the Central Office kept constantly and closely in touch carried on this field survey.

It will be noted that the Detroit prices of articles of consumption were estimates derived by dividing the total cost by the reported quantity. On the other hand, the European prices were actual prices secured by direct inquiry.

The European budgets used for weighting purposes were not all of equal validity either as respects type of working class consumer or in point of timeliness. The European studies included Germany, 1928–29; Poland, 1927; Belgium, 1928–29; Denmark, 1922; Sweden, 1923; Finland, 1921–22; Ireland, 1921; The Netherlands, 1923–24. No such budgetary studies exist in the case of France, Spain, and Turkey, and reliance had to be made, therefore, on some estimated consumption data available from the internal revenue statistics of France and Spain and a hypothetical budget of the Istanbul Chamber of Commerce in the case of Turkey. The British have a pre-war estimated budget of working-class consumption which dates from 1904. This was supplemented and brought up to date by post-war official data and estimates of various sorts.

The Detroit budget with its quantities and values, and the European prices of Detroit commodities, together with the European budgets, constituted then the basic raw material for making the index number of comparative costs of living. The quantity items supply the weighting of the prices and values and show the relative importance of the different items of expenditure. Both the Detroit and European quantities are essential. If only the Detroit quantities of consumption had been utilized for weighting, the effects of different habits of consumption—Europe versus the United States—would have been lost.

As an index number problem it is one of establishing a price relative weighted with actual consumption in Detroit and then to compare it with another relative weighted with actual consumption items in another place so as to bring out those differences. This becomes easier to understand if a substitution of the words "place" and "difference" is made for the words "change" and "time." If the problem had been that of comparing prices of household consumption articles in Detroit in 1880 and in 1930 prices would be weighted by the consumption of those years so as to allow for changes (differences) in habits of consumption between the two periods (places). In the present inquiry by the International Labor Office the problem becomes one of comparison in space (different places) as against one in time (different years).

The particular questions of technique that presented themselves as the study progressed are best shown by a description of the method employed in translating the different groups of items of the Detroit workers' budget into their equivalents in the budgets of the workers in the European cities. Departures from some of the general principles laid down at the start were found necessary. Compromises were made. The rule, for example, that the problem was not one of transferring the Detroit worker to a European environment where he might be imagined

as buying and consuming the identical articles he enjoys as his standard in Detroit was not always observed. In weighting, account could not always be taken of all the items in some of the expenditure groups such as the miscellaneous group, health and hygiene expenditures. Housing, also, presented difficulties of a special kind.

Two tasks were presented: first, to obtain trustworthy comparative price data in the different European cities; and, second, to find the relative level of food prices in each European city as compared with that in Detroit.

The Detroit list of food stuffs was circulated in the different cities. Distinction was made between the chief articles of food and the less important ones. It was not felt necessary to secure prices for all the minor articles on which less than one dollar a year was spent. A careful description of grade and quality was furnished. All food shown in the Detroit budget was converted into caloric values and content in protein, calcium, phosphorus, etc.

The system of cross weighting was used: Actual consumption in the base town, Detroit, and general consumption in the given European country, as shown in budgetary inquiries of various sorts already mentioned; two ratios of prices were calculated, the one a relative of the two sets of prices weighted by Detroit consumption, the second, a relative of the same set of prices weighted by the European standard of consumption. The geometric average of these two ratios was then calculated. The result was an index number of the cost of food in a given European city with the Detroit cost as a base.[1] The same set of prices entered into each ratio. Hence the controlling factor of change is the weighting. An example of the process is contained in Table III in the appendix for the city Copenhagen. Similar tables were worked out for every other city, the results of which are shown in Table IV.

The two ratios of food costs show on the one hand how much less it would cost an American worker to live in the European cities with his customary standard of consumption, and, on the other, how much more it would cost the European worker to live in Detroit on his customary standard of consumption. The difference in the cost of food as between the two localities would lie somewhere between those two extremes.

[1] In constructing its price (cost) relative and comparing costs in Detroit and the European cities, the International Labor Office used Fisher's "Ideal" formula from his study of *The Making of Index Numbers*; a formula which Fisher insists should also be credited to, and as having been hit upon independently by, Walsh, Edgeworth, Pigou and Young; now utilized also by Keynes in *A Treatise on Money* and by Haberler in *Der Sinn der Indexzahlen*. That price index formula is as follows:

$$\text{Index} = 100 \times \sqrt{\frac{\Sigma p_1 q_1}{\Sigma p_0 q_0} \times \frac{\Sigma p_1 q_1}{\Sigma p_0 q_0}}.$$

To test the accuracy of the method of weighting, budgets of different levels of consumption in the European cities were taken as the weights. Tested out in the case of Germany it did not seem to make much difference whether the weights used were taken from budgets of high-paid officials or of the low-paid working man. One element of approximation should, however, be taken into account; that is, that the Detroit prices were averages obtained by dividing the expenditure on a particular item by the quantity bought, while the European prices were based on quotations taken at the time of the survey in the different European cities. While no tests of the error introduced by this method have been made, the Office believes that "the averages shown for each town are as accurate as the data warrant and may be looked upon as fairly reliable."

The German statistical office suggested a different method of calculating the relative food expenditures. The German authorities selected twenty-nine articles of food consumption common to both the Detroit and the German budgets in Frankfurt and Berlin. They found the cost of the Detroit quantities in terms of the prices in Frankfurt and Berlin. Certain German articles were substituted for the Detroit items where the price of the Detroit article in Germany seemed out of harmony with the American price. This obviously introduces an arbitrary element of choice. The basis of the choice for the Berlin authorities was the caloric content of the comparable items of food. The net result of the method was, therefore, to compare food consumption on the basis of caloric content. This is not necessarily a true comparison under the newer dispensation of food values, and its emphasis upon vitamins. In their statistical formula the Germans departed from the ideal formula with its cross-weighting of the Detroit prices in Berlin quantities, and vice versa, and used only the first part of the formula, that is, weighting by the Detroit items of consumption. The German method, therefore, assumed that the differences in food consumption between Detroit and the two German cities were adequately accounted for in the substitutions which they made for the Detroit items in securing German prices. On the other hand, the method of the International Labor Office of weighting with Berlin consumption items would seem to introduce less of an arbitrary element and to take more proper account of German consumption habits. The practical difference between the two methods was not great and the Office accepted the German results as a lower limit of food costs as is shown in Table I.

The Swedish authorities likewise proposed an alternative method for handling the food expenditures. First they divided the consumption

of the Detroit and Stockholm families into two groups comprising (a) important food stuffs that were basic to the nutritive standards of western Europe, (b) all other food stuffs. Second, they ascertained the average price per caloric for each of these groups. Third, they calculated the cost of the calories consumed in Detroit for the two groups of food stuffs in terms of the Swedish price per calorie. Fourth, they considered the sum of the Swedish results so obtained separately for the two groups of food expenditures as the true expenditure equivalent to the total Detroit expenditure. That is to say, instead of comparing actual quantities of food consumed, the Swedish authorities compared calories utilized, which is very questionable as pointed out also in the case of the German method. What the Swedish authorities secured was a price relative of calories and not of food stuffs. They seem, therefore, to have left out of consideration the element of psychological choice. Besides, the division of food stuffs into two groups of commodities, classified as "more important" and "less important," introduces an arbitrary element into a situation where the fundamental purpose is to compare free consumers' choice, as far as that is possible, through its concrete manifestations.

Comparison of housing standards in different countries is, of course, particularly difficult. Account must be taken of preference in locality of housing and particularly the existence in Europe of rent restriction legislation which artificially keeps down rents. What may seem to be dwellings of equal value are in one locality subject to restrictions while in another place they may be competitively priced.

The American type as shown in the Detroit study was that of the detached family house equipped with gas, electricity, and bath. But houses of that type rarely exist among the working class in Europe. Again, the comparative size of rooms is probably larger in Europe than in Detroit though the number per family is less. Bath rooms are almost unknown in European working-class dwellings.

What the Office did at first was to ask its collaborators to give them a rent figure in each town for a dwelling approximately equivalent, leaving to each investigator his interpretation of what he considered "equivalent" to the Detroit standard. Finally, after consultation with the special group of statisticians in Geneva in May it was decided to present a lower and upper limit for rent. The lower limit represented the rent of a house actually occupied by the working class in the given town. This house had four to five rooms and was situated in a working-class district. Although the working man does not occupy houses of that size and character it was considered typical of the lower range of housing and accommodations if found in a working-class

district. The upper limit of rent was to refer to an apartment or house which should be as identical as possible in every detail with the American type.

The theory underlying the lower limit is that the number of rooms is basic to the standard chosen by a given group in the community. The lower limit reveals the real housing standard of the European in his own environment.

The theory underlying the upper limit implies that "equivalent" means identical. It makes the equipment of the house equally important with its size and location and assumes that these yield the same amount of satisfaction in different cultural milieus. As far as European cities were concerned it was quite unrealistic. No houses of that quality were occupied by working men. Moreover, such an interpretation of housing equivalence represents the principle of transference of the American worker to a European environment, and exaggerates the cost of housing in the European cities as compared with Detroit costs.

As regards fuel and light, calculations were not based upon the quantities of fuel, gas or electricity consumed in Detroit, but on the actual consumption usual in the European towns. As information on actual consumption was not available various devices had to be resorted to in securing what seemed to be an equivalent of fuel and light consumption in the European towns compared with Detroit. It was found in Germany, for example, that the expenditure for fuel and light was comparatively constant. Consequently the expenditure for fuel and light for four and a half rooms was adopted as constant. In Finland allowance had to be made for the predominant use of wood instead of coal.

In making comparisons in clothing expenditures actual samples like those worn by the Detroit families were available. These were circulated in each city and quotations obtained from representative stores. Where no articles similar to the samples were available upon which prices could be secured, recourse had to be had to prices of articles corresponding in use to the Detroit samples.

Particular difficulty was found in ascertaining equivalents in the case of women's and children's clothes. Here the question of cut and style was introduced. Especially in the case of children's clothing no prices could be secured, as children's clothing is generally made in the home by the European housewife.

For a full and accurate comparison of clothing expenditure it would have been necessary to secure prices in Detroit of samples taken from each European city. But as this was technically impossible calculations were based wholly on the Detroit quantities consumed.

The Detroit quantity budget of clothing was priced in the different cities insofar as prices of similar equivalent articles could be secured. As a matter of fact the procedure applied to about sixty per cent of the quantity of clothing used by Detroit working men. A similar procedure was followed in the case of clothing for women and children where the American articles were found priceable in the European stores. For example, a certain number of suits, shoes, etc., in Detroit, when priced in Copenhagen, cost 178.3 crowns as compared with 175.2 crowns in Detroit. This gives a price ratio of approximately 102 with Detroit as the base. In the case of women's clothing, the price ratio was 94, and in children's clothing 113. Each of these price ratios was applied to the total expenditure in Copenhagen yielding a total expenditure per family for clothing of 819 crowns in Copenhagen as compared with a cost of a similar lot of clothing of 786 crowns in Detroit.

A second method was employed by which the price ratios of women's and men's clothing only were applied to the total family expenditure; that is, it was thought unfair to get prices of ready-made children's clothing from Detroit in the European cities inasmuch as European housewives make practically all children's clothing at home. To include the ready-made price in the European city would have been to give undue expenditures for clothing to the European families.

The Office left it to the collaborators to decide by local habits and customs whether or not to utilize the one or the other method in clothing expenditures. Analysis of the method of securing equivalents in clothing expenditures shows that it was practically an adoption of the method of transferring the Detroit worker to the European city. It assumed that the European worker should be allowed to buy the same quality and style of clothing as that worn by the Detroit worker. Such a method does not allow for differences in national customs and climate as between American and European towns. The study of the International Labor Office comments: "The differences in the kind and quality of the specific articles of clothing appear to be subject to such variation that a special set of samples for each European town should have been sent to Detroit in order to obtain results for clothing of a similar degree of reliability as those reached for food."

The quantity measure of medical service may be expressed in number of visits of physicians and surgeons and visits to the dentists for an extraction or ordinary filling. Detroit family expenditures indicate approximately nine and a half visits to the physicians, six and a half house calls, and ten dental visits. The cost of these was found in the European cities and the ratio applied to the total expenditures borne in the Detroit family. This assumes the average state of health and

sickness the same in the cities compared. Another shortcoming here was that no way was devised of ascertaining what proportion of the medical expenditures was incurred by the different members of the family.

Obviously the group of miscellaneous expenditures proved the most difficult to state in any terms of equivalents of consumption. The outcome again was practically to assume the transfer of the American worker to Europe. The method is, therefore, a bias against the European standard and takes no account of habits and customs. Yet it is in this group of expenditures that individual idiosyncracies, personal choices, and indeterminable desires have their greatest play. Moreover, the averages are based upon the choices of one hundred families and are therefore particularly liable to error on account of the smallness of the sample.

Two methods were considered for dealing with this group of expenditures. The first was to allow for the whole of this group by a percentage addition to the total obtained from all the preceding sections of the budget; that is, allowing the European worker the same percentage of his total expenditure as the Detroit worker for these same items. It was assumed that the price ratio for this group was the same as that found for the total of the other groups.

The second method was to apply the usual price ratio method, obtaining prices for as many comparable articles and services as possible. But if this were to be applied only those items for which a definite unit price was shown in the Detroit budget could be utilized. That meant using very few items of miscellaneous expenditures for the weights; such as the cost of magazine subscriptions, the evening paper, the amount of tobacco consumed, postage spent, number of telephone calls, motion picture attendance, number of haircuts, number of streetcar fares, laundry charges, and so forth.

The second method was, however, adopted as tests showed that the proportion of the total miscellaneous expenditures which the European worker spent on the itemized quantities indicated above did not vary greatly from what the Detroit worker spent for the same group of items. This percentage was between 18 and 24 of the total budgetary expenditures in the European cities as compared with 20 per cent in the Detroit budgetary set-up.

Social insurance in Europe was treated as an actual expenditure and estimated as such in the European budget. It was handled in connection with expenditures for health and offset against the health expenditures of the Detroit worker. The Detroit expenditure (premium) for life insurance, which appeared to be about 3 per cent of a principle sum

equal to 120 per cent of the annual budget, was assigned an equivalent purchasing power in the European worker's budget. The European worker's expenditure for direct taxes was also considered as something for which he must budget. "Whatever the European worker got for his taxes was assumed to be as much as what the Detroit workers who pay no taxes got for nothing."

In any case, the sums here are so small in comparison with the whole budget that it would have been possible perhaps to take no account of such expenditures on either side and to rest the final conclusions upon the major items—food, housing, clothing, fuel and light—which can be expressed in more adequate quantity notations and consequently priced with greater accuracy.

The major results of the study are set forth in the statistical tables appended. Briefly summarized, the cost of living in the fourteen European cities singled out for the inquiry ranges from 4 per cent higher in Stockholm down to 43 per cent lower in Barcelona, than in Detroit. In some cities a minimum and maximum range is shown arising from certain differences in method explained above. There are apparent two extremes of cities from northern European cities to those in the south, and further east. Taking the northern European cities the close approximation of the costs of living in them to costs in Detroit is noteworthy. With Detroit as 100, the cities range themselves as follows:

Detroit	100
Berlin	79–86
Frankfurt	82–89
Copenhagen	83–91
Stockholm	98–104
Helsinki	83
Paris	80–87
Marseilles	75–81
Antwerp	61–65
Rotterdam	64–67
Manchester	69–73
Cork	85
Warsaw	64
Barcelona	57
Istanbul	65*

* Excluding direct taxation.

Obviously, a study limited to such few urban centers in Europe should not be interpreted as if it were an adequate comparison between European and American costs of living. The International Labor Office has called this study merely "a contribution" to the problem of comparing living costs in the different countries.

Furthermore, such a study should not be used as the basis of any broad comparison of real wages. It was not a survey of actual expenditures of European workers' families in the cities covered. It did not, therefore, reflect any particular income (expenditure) level, or actual level of wages in those cities. Certainly it would not be fair to make broad deductions as to real wages in Europe on the basis of the cost of living in a few centers. Every country shows within its own borders a considerable diversity of living costs, diversities probably as great as those shown between Detroit and the cities covered in this survey.

Primarily, it is as a contribution to the methodology of comparing international costs of living that the study will be most worth while. The method utilized has been demonstrated as feasible even though it could be improved along one or two additional points of technique.

First, instead of weighting the European prices with budgets of general working class consumption in each of the countries where the cities were located it would, on the face of it, no doubt have been more desirable to establish new budget studies in the cities in question for the working class group corresponding to the one in Detroit. However, as tests proved, weighting the European prices with different budgetary studies not only of working class consumption but of higher salaried groups did not seem to make much difference. Apparently habits of consumption in Europe are more homogeneous than one generally suspects.

The second element of technique that should be introduced into a newer and broader survey is the use of an itinerant commission of survey to trail and supervise the inquiry from start to finish so as to bring to bear upon it certain qualitative "standards of appreciation" as to what constitutes equivalence of material comforts. In the present study this sort of common standard of appreciation was furnished partly by the single expert of the International Labor Office who saw conditions in Detroit and visited most of the European cities surveyed, and partly by the conference of statisticians who had supervised the national surveys and who met at Genevà and, like a sort of coroner's jury, sat on the results which the International Labor Office experts laid before them. Several moot points were thrashed out at this conference and distinct improvements made in the study. In any new and wider survey this conference of statisticians could be turned into a sort of peripatetic commission of observation and supervision of the study from beginning to end.

APPENDIX

TABLE I

AMOUNTS THAT WOULD HAVE TO BE SPENT BY WORKERS IN CERTAIN EUROPEAN TOWNS IN JANUARY, 1931, IN ORDER TO OBTAIN A STANDARD OF LIVING APPROXIMATELY EQUIVALENT TO THAT OF AN AVERAGE WORKING-CLASS FAMILY IN DETROIT WHOSE EXPENDITURE WAS EQUIVALENT TO ABOUT $1,550 IN JANUARY, 1931

(Absolute figures in dollars)

City	Food $	Housing $	Fuel and light $	Clothing $	Total for food, housing, fuel and light, and clothing $
Detroit	408	350	100	105	1,113
Berlin	387-402	242-328	43	157	820-930
Frankfurt	420-452	242-328	43	157	872-980
Copenhagen	381	214-322	64-71	193	852-967
Stockholm	359-434	402	*52*	*213*	*1,020-1,101*
Helsinki	298	340	61	173	872
Paris	465	172-274	69	209	914-1,017
Marseilles	427	148-235	51	209	835-922
Antwerp	385	121-181	30	170	677-766
Rotterdam	393	*150-201*	*44*	*117*	*711-756*
Manchester	380-417	152-165	88-102	133	703-817
Cork	446	170	101	191	908
Warsaw	253	178	68	151	650
Barcelona	274	103	64	127	568
Istanbul	300	*141*	*59*	221	*721*

City	Other expenditures: Medical expense $	Other expenditures: Life insurance $	Other expenditures: Miscellaneous $	Cost of living, excluding direct taxation $	Total cost of living $
Detroit	61	56	321	1,551	1,551
Berlin	44	29-33	268	1,172-1,270	1,222-1,333
Frankfurt	44	31-34	204	1,211-1,323	1,264-1,382
Copenhagen	28	45-49	305	1,251-1,349	1,286-1,416
Stockholm	38	52-56	322	1,440-1,519	1,520-1,613
Helsinki	45	45	224	1,188	1,284
Paris	26	*44-48*	*239*	1,224-1,330	1,239-1,349
Marseilles	26	41-45	241	1,145-1,235	1,160-1,249
Antwerp	20	30-32	200	928-999	945-1,010
Rotterdam	23	23	198	959-1,000	988-1,033
Manchester	38	36-37	240	1,071-1,120	1,071-1,120
Cork	39	*35*	339	1,320	1,320
Warsaw	30	33	233	948	924
Barcelona	22	28	184	775	855
Istanbul	20	36	236	1,014	......

TABLE II

INDEX NUMBERS OF AMOUNTS THAT WOULD HAVE TO BE SPENT BY WORKERS IN CERTAIN EUROPEAN TOWNS IN JANUARY, 1931, IN ORDER TO OBTAIN A STANDARD OF LIVING APPROXIMATELY EQUIVALENT TO THAT OF AN AVERAGE WORKING-CLASS FAMILY IN DETROIT WHOSE EXPENDITURE IN 1931 WAS EQUIVALENT TO ABOUT $1,550

(Base: Detroit = 100)

City	Food	Housing	Fuel and light	Clothing	Total for food, housing, fuel and light, and clothing
Detroit	100	100	100	100	100
Berlin	60	04	43	81	84
Frankfurt	07	04	71	81	88
Copenhagen	81	02	43	00	87
Stockholm	03	115	52	100	00
Helsinki	04	07	61	80	70
Paris	00	78	00	107	01
Marseilles	01	07	61	107	83
Antwerp	70	62	30	87	00
Rotterdam	84	57	45	60	09
Manchester	80	47	102	08	73
Cork	05	40	101	08	82
Warsaw	54	51	08	77	08
Barcelona	58	20	64	07	50
Istanbul	04	40	50	113	65

City	Other expenditures			Cost of living, excluding direct taxation	Total cost of living
	Medical expense	Life insurance	Miscellaneous		
Detroit	100	100	100	100	100
Berlin	72	50	84	82	86
Frankfurt	72	63	82	85	80
Copenhagen	40	80	05	87	01
Stockholm	04	100	101	08	104
Helsinki	75	80	70	77	83
Paris	43	80	74	80	87
Marseilles	43	81	75	80	81
Antwerp	34	50	02	64	05
Rotterdam	38	43	02	65	67
Manchester	30	00	78	73	73
Cork	00	80	08	85	85
Warsaw	51	01	73	61	64
Barcelona	30	52	50	52	57
Istanbul	33	06	74	65	....

TABLE III

TOTAL QUANTITIES AND COST OF FOOD CONSUMED PER FAMILY (3.27 ADULT UNITS) IN DETROIT AND COPENHAGEN WEIGHTED ALTERNATELY IN TERMS OF THE AMOUNT CONSUMED AND PRICES IN THE OTHER CITY

Foodstuffs (Detroit designation)	Quantities consumed per family of 3.27 units		Prices per unit	
	Detroit	Copenhagen	Detroit	Copenhagen
	(1) Kg.	(2) Kg.	(3) Öre	(4) Öre
Beef, fresh, steak	17.4	37.01	321.7	181
Beef, fresh, roast	22.5		273.1	
Veal	7.4	20.17	276.5	104
Pork, fresh	30.2	15.92	221.3	104
Pork, salt (bacon and ham)	24.7	18.47	246.7	200
Cooked meat (beside ham)	7.6	12.40	258.4	248
Fish, fresh	7.0	20.24	230.1	115
Fish, salt	1.8	1.44	228.6	88
Milk, fresh	507.0	389.40	51.8	32
Butter	30.0	30.28	413.8	204
Butter substitutes	11.6	51.31	186.7	146
Cheese	7.3	19.88	278.0	248
Lard	22.1	10.37	134.0	156
Eggs	55.0	29.66	247.6	176
Flour, wheaten	87.0	51.27	39.5	34
Bread, wheaten	230.1	67.00	67.5	77
Bread, rye	50.9	230.80	75.0	19
Sugar	88.6	114.48	53.6	42
Potatoes, Irish	268.3	275.60	20.5	13
Tea	2.3	1.24	603.0	900
Coffee	14.8	15.70	322.5	428

Foodstuffs (Detroit designation)	Products			
	Col. (1) and (3)	Col. (1) and (4)	Col. (2) and (3)	Col. (2) and (4)
	(5) Kr.	(6) Kr.	(7) Kr.	(8) Kr.
Beef, fresh, steak	55.98	31.49	110.07	66.99
Beef, fresh, roast	61.45	40.73		
Veal	20.46	14.36	80.60	56.50
Pork, fresh	66.83	58.59	35.23	30.80
Pork, salt (bacon and ham)	60.93	49.40	45.57	36.94
Cooked meat (beside ham)	19.64	18.85	32.27	30.08
Fish, fresh	18.66	9.09	47.70	23.28
Fish, salt	4.11	1.58	3.30	1.27
Milk, fresh	262.63	162.24	201.70	124.61
Butter	123.14	88.20	125.30	89.02
Butter substitutes	21.66	16.94	95.80	74.91
Cheese	20.30	18.10	55.45	49.30
Lard	29.61	34.48	13.90	16.18
Eggs	136.18	96.80	73.44	52.20
Flour, wheaten	34.37	29.58	20.25	17.43
Bread, wheaten	159.37	181.80	45.23	51.59
Bread, rye	38.18	9.67	173.15	43.86
Sugar	47.49	37.31	61.36	48.08
Potatoes, Irish	55.00	34.88	56.50	35.84
Tea	13.87	20.70	7.48	11.16
Coffee	47.73	63.34	50.63	67.45
Totals	1,298.84	1,018.93	1,336.52	928.60

Ratio I: $\frac{\text{Column 6}}{\text{Column 5}} = 0.781$ } Average (geometric) = 0.738 or 73.8 per cent of Detroit prices.
Ratio II: $\frac{\text{Column 8}}{\text{Column 7}} = 0.695$

TABLE IV

RATIO OF FOOD EXPENDITURES IN VARIOUS CITIES TO EXPENDITURES IN DETROIT

City	Detroit weights	Other town weights	Geometric average
Copenhagen	78.4	69.5	73.8
Berlin	82.3	67.0	74.0
Frankfurt	93.5	75.1	83.8
Stockholm	89.8	73.9	81.4
Helsinki	70.5	47.0	57.6
Paris	85.0	81.4	83.0
Marseilles	78.5	72.7	75.5
Antwerp	74.3	63.1	68.4
Rotterdam	81.4	67.8	74.3
Manchester	77.0	67.7	72.2
Cork	81.9	80.7	81.3
Warsaw	62.0	44.1	52.5
Barcelona	51.5	45.7	48.5
Istanbul	58.4	50.0	54.0

TABLE V

EFFECT OF DIFFERENT CONSUMPTION WEIGHTS ON THE RESULT OF THE COMPARISON OF FOOD PRICES IN TWO COUNTRIES*

Group and series number of comparison	Number of foodstuffs considered	Prices used †		Consumption weights used ‡		Result of the "ideal" formula (prices in base town = 100)
		Base town	Other town	Base town	Other town	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
I: (1)	20	Detroit	Berlin	Detroit workers	German workers spending per man-unit in 1927-28: RM. 1,150.60	74.8
(2)	"	"	"	" "	German officials spending per man-unit in 1927-28: RM. 3,409.05	75.8
(3)	"	"	Frankfort on the Main	" "	German workers spending per man-unit in 1927-28: RM. 1,150.60	83.8
(4)	"	"	"	" "	German officials spending per man-unit in 1927-28: RM. 3,409.05	84.0
II: (1)	20	Copenhagen	Warsaw	Copenhagen families spending per man-unit in 1922 about: Kr. 2,600	Warsaw workers spending per man-unit in 1932 about: Zl. 832	70.1
(2)	"	"	"	4,250	500	70.0
(3)	"	"	"	1,300	1,550	78.2
(4)	"	"	"	4,250	1,550	77.4
(5)	"	"	"	1,300	500	80.8
III: (1)	20	Stockholm	Helsinki	Stockholm families spending per man-unit in 1922-23 about: Kr. 1,570	Finnish workers spending per man-unit in 1920-21 about: F. Mks. 6,440	73.2
(2)	"	"	"	2,250	4,630	71.1
(3)	"	"	"	1,140	6,810	73.0
(4)	"	"	"	2,250	6,810	72.0
(5)	"	"	"	1,140	4,630	71.5

* From *International Labor Review*, September, 1932.

† Prices as supplied by the statistical authorities of the countries concerned. The original data used are reproduced in the appendices to the respective town reports in the Office study.

‡ The consumption weights are derived from the sources given in the footnotes to Table I of the respective town reports in the Office study. The lists of articles included are so established as to include the largest possible number of foodstuffs appearing in both budgets, taking into consideration the prices available.

AN ORDINAL INDEX OF CORRELATION

By G. P. Watkins

The use of numbers indicating rank or position is not unknown in statistical analysis and exposition, and the median, or middle position, which is the average pertaining to this type of numbers, is quite familiar. Such numbers are worthy of more systematic consideration and should have a more distinctive name. The latter is furnished by old-fashioned arithmetic, which distinguishes *ordinal* from cardinal numbers. More needs to be said about the use of ordinals in statistics generally, but this article is sufficiently occupied with the consideration of the possibilities of an ordinal index of correlation.

The methods of ordinal analysis are believed to be especially applicable to economic studies, that is, to a region where quantitative data are so often very heterogeneous and the unit of measurement so largely pecuniary—a unit which does not lend itself to "exact" science—that the quantities obtained do not always afford satisfactory premises for mathematical deductions of the usual kind.

As statistically developed, correlation is the concise expression of the interrelation of two series of quantitatively determined attributes or items, or of two frequency distributions, as brought out through pairing or through cross classification. A "scatter" diagram presents the basic situation to the eye; and a "correlation table" (cross classification in terms of two frequency distributions) does the same sort of thing, though without giving all the detail. The measurement of correlation is entirely a matter of interpretation and condensation of such numerical data.

The two frequency distributions may as well be two ordinal series.[1]

[1] The idea of using ordinals or "ranks" as the basis for computing correlation coefficients is developed by C. Spearman, the most pertinent of his contributions being "The Proof and Measurement of the Association between Two Things" (*American Journal of Psychology*, Vol. XV, 1904) and "Footrule for Measuring Correlation" (*British Journal of Psychology*, Vol. II, 1906). He switches from ordinal conceptions, however, and applies Pearsonian methods in his final analysis. Of collateral interest, also, is a series of articles by A. S. Otis in Vol. IV of *School and Society* (1916), "The Reliability of Spelling Scales, Involving a 'Deviation' Formula for Correlation," which develops, on the basis of median deviations, certain partial alternatives to Pearsonian methods. It appears that "rank" methods are in considerable use in psychological and educational studies. Truman L. Kelley, *Statistical Method*, deals with Spearman's formula incidentally. The general statistical textbooks of Chaddock and Day touch the subject rather casually.

Since the completion of the manuscript here printed, certain articles by H. Striefler in the *Deutsches Statistiches Centralblatt* for July-August and September, 1931 (Zur Methode der Rangkorrelation nach Tönnies) have come to the writer's attention. The method described is legitimately and consistently ordinal, but diagrammatic rather than directly numerical in its development. Tönnies appears to have fixed on 5 groups per series as basic and does not provide for taking into account all possible relationships of the pairs (of the 5 groups). Striefler (referring in this connection to an unpublished manu-

Thus classification is pushed beyond itself to become the individual ranking of each specific item. The scale in terms of absolute quantity thereby drops out. The density of distribution will perhaps usually vary in about the same way for two related series of an equal number of items; but it may be more to the point to find that, if ordinals are used, it is unimportant that the frequency distributions be either regular or similar.

The *interrelation of two ordinal series*—after being put in parallel columns, the items of which may conveniently be arranged so that one series is in regular 1–2–3 order and the other in such arrangement as results from pairing with the controlling series—may be expressed numerically as described below. But the significant comparison of ordinal series is not dependent upon the computation of a numerical index.

Displacement across the median. If the relation between two series of ordinals is a perfectly chance or random matter, then, among other things, the first half of one series (as arranged in regular order) will be paired with a set of numbers from the other (or subordinated) series whose sum is approximately one-half the sum of the series. A marked departure from the division of the items of the subordinate series into two parts equal in number whose sums are equal indicates correlation, either negative or positive—positive as the sum of the ordinals paired with the first half of the regularly arranged series approaches the minimum obtainable sum for half the series (that is for half of the regularly arranged series, the *first* half) and negative as this sum approaches the possible maximum (that for the second half of the regularly arranged series which is composed of the larger ordinals).[1]

Upon this basis an index of correlation can be computed.[2] But this

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script by Kurt Pohlen) develops the method for more groups and for all pairings. Pohlen's method (as distinguished from Tönnies') moreover, gives the coincidence of extreme ranks greater weight than that of intermediate ranks.

[1] Since attention to the items paired with the second half gives a complementary result, the comparison may best be made for both halves and thus become self-checking. Moreover, since there is no ground for a preference as to which series shall be regularly arranged or controlling, and since results differ according to which is so used, a numerical index should be the average of the displacement across the median as computed with one and then with the other series controlling.

[2] The index is the ratio of the displacement across the median in the second-term series, as averaged for the two series alternately thus subordinated, to the maximum possible divergence of the halves of the two series. The maximum is shown by the regularly arranged, or controlling, series. The paired items in the subordinate series may conceivably arrange themselves also with perfect regularity, either in the order of the controlling series, thereby showing 100 per cent positive correlation, or in exact reverse order, thereby showing 100 per cent negative correlation.

Ordinals constitute an arithmetical progression. Advantage may be taken of this in computing and checking, especially in relation to a correlation index. The sum of a series of ordinals is equal to the product of one-half the number of items in the series times the sum of the highest and lowest ordinals (the latter being 1 in this case). For example, if there are 305 ordinals in the series its sum is $\frac{305}{2} \times (305+1)$, or 60,705. Partial sums of a series of ordinals, taken all together, must equal the same amount. Sums of parts of series in regular order may be similarly computed.

method is crude, since it takes account of displacement of rank only as it carries the members of a pair to opposite sides of the median. It appears likely that, the longer the series, the greater the need of using some method that takes account of displacement in greater detail. The across-the-median method is perhaps mainly of collateral interest.[1]

More detail can be brought into the calculation, either by utilizing further divisions of the percentile scale (of which deciles are perhaps to be preferred) or by computing individual displacement away from a perfect matching of the two series compared.

Specific displacement. By the specific-displacement method the differences in ranks, with plus or minus signs, are obtained for the members of each pair of ordinals. The ordinal series, of course, begin with 1. The sum of the plus and of the minus differences must be the same, the differences being thus self-checking.

With a random distribution of one series of ordinals in relation to the other (indicating zero correlation) the sum of differences (signs disregarded) will be at the half-way point between the maximum possible sum, indicating perfect negative correlation, and a zero sum, indicating perfect positive correlation. Hence the departure of the actual sum (signs disregarded) from one-half the maximum possible sum (signs disregarded) is the numerator of a fraction that yields a proposed measure of correlation.

The denominator of this fraction (or the divisor) is one-half the maximum possible sum.

Correlation is indicated as negative or positive according to whether the actual sum of differences is nearer the maximum possible sum or nearer zero.

The maximum possible sum of differences between ordinals can be obtained by pairing the ordinals in reverse order for subtraction. It can also easily be computed by means of arithmetical progression. Its mathematical derivation is as follows.

With the differences derived from two regularly arranged series of ordinals that are in reverse order (each series beginning with 1) the difference series (the items of which, with signs disregarded, add to the maximum possible sum of differences) constitutes an arithmetical progression in steps of 2 each. This difference series contains the same number of items as either ordinal series, and it passes through the zero point and is half plus and half minus. Hence it may conveniently be regarded arithmetically as two identical series (arithmetical progres-

[1] Ordinal analysis has been used as a measure of correlation and otherwise by the writer in certain reports of the Federal Trade Commission, and developed progressively in that connection. See reports on the *Grain Trade*, Vols. VI and VII, *Cotton Trade*, and *Open-Price Trade Associations*, for uses made of the across-the-median method.

sions) one plus and the other minus, both beginning with 1 or both with zero. The smallest difference item (disregarding signs) is zero if the largest ordinal is an odd number, and 1 if the largest ordinal is even. The largest difference is 1 less than the largest ordinal. The number of items in each of the difference progressions is half the largest ordinal number (and also of the number of items in the ordinal series) if that is even and if the differences, therefore, include $n+1$ and $n-1$. In principle the same rule holds for an odd largest ordinal, but it is proper and convenient to include the zero (which in this case is the smallest difference) in both difference series or progressions. Hence the number of items in each of the two difference series is half the next higher integer if the largest ordinal is odd.

Therefore, according to the formula for computing the sum of the items of an arithmetical progression, namely, that it is the product of one-half the number of items in the progression multiplied into the sum of the largest and smallest items, the maximum possible sum of differences may be computed directly from the ordinal series. The fraction used below becomes ¼ instead of ½ because the difference series is divided into two progressions. If

F denotes the maximum possible sum of differences, and

g the largest ordinal if even, and

h the largest ordinal if odd, then, for an *even* number of ordinals,

$$F=\tfrac{1}{4}g[(g-1)+1]+\tfrac{1}{4}g[(g-1)+1]=\frac{g^2}{2}$$

and for an *odd* number of ordinals,

$$F=\tfrac{1}{4}(h+1)[(h-1)+0]+\tfrac{1}{4}(h+1)[(h-1)+0]=\frac{(h+1)(h-1)}{2}.$$

Arithmetical examples of the above described numerical relations are presented in a footnote.[1]

[1] The following comparative examples—for series of 11, 10, 9, and 8 items—may serve to clarify the numerical relations of the fundamental series.

	Sum of ordinal series
For 11 items	5½×(11+1)=66
For 10 items	5 ×(10+1)=55
For 9 items	4½×(9+1)=45
For 8 items	4 ×(8+1)=36
	Sum of corresponding maximum-difference series
For 11 items	½×10×12=60
For 10 items	½×10×10=50
For 9 items	½× 8×10=40
For 8 items	½× 8× 8=32

Whether the smallest or the largest items in the two original series are assigned first rank makes no difference in the result except as regards the plus or minus sign prefixed to the index; and it is entirely arbitrary or conventional which direction of correlation shall be called negative or positive. But the differences and their sum are affected by inverting one of the ordinal series (not both) in making the above computation.[1] Hence the average of the results of the two alternatives should be taken to arrive at the index. But the inversion of one series of ordinals gives directly a result that carries a sign the opposite of the first one, hence the figure that can be added to (or averaged with) the numerator of the correlation fraction above described is the complement of this alternative figure, or the difference between it and half the maximum possible sum of differences. The final index may conveniently be computed by adding the two numerators (with due regard to the significance of their signs) and using the maximum possible sum of differences as the denominator. Algebraic formulas follow.

With the value of F (the maximum possible sum of differences) already defined, and with

Σ denoting summation with signs disregarded, and

x_{id} any item of the one ordinal series, and

y_{id} any item of the paired ordinal series, then the first stage of the formula for the specific-displacement ordinal index may be shown thus:

$$\frac{\Sigma(x_{id}-y_{id})-\frac{1}{2}F}{\frac{1}{2}F}.$$

However, the result of inverting one of the ordinal series (either one) before obtaining the actual difference series should be taken into account.

With y_{iv} denoting the item in the inverted y series that corresponds (after inversion) to any item y_{id} of the direct series, then, in order to include in the formula, by way of averaging (dividing the combination by 2) the result of inversion (and also the reversed significance of the negative or positive sign in the two results) the formula becomes:

$$\frac{[\Sigma(x_{id}-y_{id})-\frac{1}{2}F]-[\Sigma(x_{id}-y_{iv})-\frac{1}{2}F]}{F}.$$

[1] By the specific-displacement method arrangement with reference to a half-way point makes no difference and there is no necessity of comparing a regularly arranged with a subordinated series (though it may be convenient) since the computation shows the specific numerical relation between the positions of the two members of each pair of items. But the inversion of one ordinal series does not result merely in a negative index equivalent to the positive index obtained before such inversion, unless the two series of ordinals are identical as paired or are exactly the reverse of each other. *The relations of the results of inversion under different arrangements of the ordinals might well be further studied.* The computation of an index on the basis of both approaches gives the benefit of averaging, of course, and perhaps also that of compensating for reciprocal lop-sidedness in one-way computations.

It should be noted that the second half of the numerator is usually (though not necessarily) negative if the first half is positive; so that the arithmetical effect of the combination of the two is usually that of addition. On page 147 the operations involved in the derivation of the index are shown arithmetically. Illustrations of the difference series involved are shown in the footnote on page 145.

The result obtained by the specific-displacement method is the ordinal index of correlation that is chiefly discussed in the following pages. The term "coefficient" is felt to be too ambitious for any form of the ordinal index.

Decile-grade displacement. Much detail can be used in the computation without taking account of individual specific displacements. With one series arranged in regular order and divided into 10 equal parts, the number of steps away from complete matching by decile grades may be computed. The sum of the displacement thus measured is then related to the maximum possible amount of corresponding decile-grade displacement.

If the items of the series are 10 in number, this procedure is identical with that of the method of specific displacement. For 10 items, the maximum possible sum of differences of position between paired items is 50. With zero correlation the sum of differences between ordinal pairs is 25; and if the sum of differences is greater than 25, there is negative correlation in the ratio of that excess to 25; and if less, positive correlation similarly.

If the number of items is 100, then the maximum possible sum of decile-grade differences is 500; and this maximum is always in direct proportion to the number of items in the series. The actual displacements will presumably be 10 times as numerous (or in proportion to the increase in the number of items) varying, of course, with the degree of correlation exhibited.

It should be noted that, for example, where an ordinal in the second decile grade is paired with an ordinal in the 6th grade, the displacement is 4 units.

In using this method it is obviously convenient to have series of such length that the number of items is a multiple of 10. Other divisions of the percentile scale might be used similarly, such as quartiles.

The use of the decile-grade instead of the specific-displacement method is favored by the fact that the variation of the number of items in the ordinal series has a significant effect on the strength of the indexes obtained. Where indexes are computed for series of varying length, the effect of close distribution of the items at the middles of the series upon ordinal differences would evidently tend to be greater the greater the length of the series. Hence there is occasion for the

use of the standardized decile-grade method wherever series of different length are to be compared. Indexes derived by the specific-displacement method for series of the same length, however, are entirely eligible for comparison among themselves.[1]

The use of the decile-grade method involves some averaging of positions, with loss of the effect of some small differences, such as occurs likewise in the use of frequency distributions. There is an advantage over the latter, however, due to the relative character of the percentile scale. The degree of condensation (and of the averaging involved) is also made constant for all series by using decile grades. Size classification thus ceases to harbor an element of arbitrariness.[2]

[1] The possible difference in the significance of a point per cent in ordinal indexes at the upper, middle, and lower portions of their size or scale of values is another matter, and not unimportant. Accidental or chance factors *may be expected to affect the different parts of the scale differently, perhaps especially* where there is an approach to the absence of either positive or negative correlation. Moreover (or especially) resistance may be greater (or elasticity less) as the 100 per cent limit is approached. Such *considerations affect the interpretation of the ratio as a coefficient, but not as an index for comparative* use, where the requirement is that the scale be constant in meaning from index to index but not necessarily have equal value (though the variation in value should be regular) for units at its different parts. *In other words, the parts of the scale of an ordinal index may need to be read differently.* The registration of the forces tending to produce perfect correlation may be subject to a principle of diminishing returns.

[2] *Examples of the arithmetical manipulation of the differences obtained by both the specific-displacement* and the decile-grade methods may best be shown together. For this purpose 20-item series for area and density have been made up (see Table II) to cover the original 13 states, Vermont, Maine and West Virginia and the four others earliest admitted to the Union. It is convenient to compute the decile-grade differences after translating longer series into the appropriate number of 10-item series. The series and differences by the two methods are then as follows:

State	Ordinal series		Specific-displacement-method differences		Decile-grade-method: Area controlling			
					Grades		Differences	
	Area	Density	Series as shown	Area inverted	Area	Density	As shown	Area inverted
Georgia	1	17	+16	−3	1	9	+8	−1
North Carolina	2	13	+11	−6	1	7	+6	−3
New York	3	5	+2	−13	2	3	+1	−6
Louisiana	4	18	+14	+1	2	9	+7	0
Pennsylvania	5	6	+1	−10	3	3	0	−5
Virginia	6	14	+8	−1	3	7	+4	−1
Tennessee	7	12	+5	−2	4	6	+2	−1
Ohio	8	7	−1	−6	4	4	0	−3
Kentucky	9	11	+2	−1	5	6	+1	0
Maine	10	20	+10	+9	5	10	+5	+4
South Carolina	11	15	+4	+5	6	8	+2	+3
West Virginia	12	10	−2	+1	6	5	−1	0
Maryland	13	8	−5	0	7	4	−3	0
Vermont	14	19	+5	+12	7	10	+3	+6
New Hampshire	15	16	+1	+10	8	8	0	+5
Massachusetts	16	2	−14	−3	8	1	−7	−2
New Jersey	17	3	−14	−1	9	2	−7	0
Connecticut	18	4	−14	+1	9	2	−7	0
Delaware	19	9	−10	+7	10	5	−5	+4
Rhode Island	20	1	−19	0	10	1	−9	0
+	...	...	+79	+46	...	...	+39	+22
−	...	...	−79	−46	...	...	−39	−22
Total	210	210	158	92	110	110	78	44

The specific-displacement method is the proper basis for an analysis designed to develop the character of ordinal methods as such. The indexes discussed below, moreover, are for series of substantially the same length, that is 49 or 48 items, except so far as they are shortened experimentally to show the effect of extreme items on computations.

The United States afford interesting possibilities of concrete illustration of correlation analysis on the basis of statistical series for the states, which series are, of course, of rather nondescript character; indeed, some lack of substantive significance in the relations of the series here used may increase their illustrative serviceability.

Detailed ordinal and pre-ordinal series for certain computations and comparisons are shown in Table II, where the consideration of the irregularity of the absolute intervals (for population density and area) corresponding to the ordinal intervals makes the presentation of such details essential. The method of computing the index is indicated in the present section merely by showing the stages of manipulation of the totals derived from four such state series; namely population in 1930, 10-year absolute increases in population, corresponding per cent increases, and density.

More than four combinations of the four ordinal series are possible, in fact six. There is seldom occasion to exhaust such possibilities, although the limitation of computation to a few comparisons preconceived to be important or to involve definite causation is, at least in economic and social statistics, not always wise.

Certain repetitions are retained in order to indicate fully the detailed processes. It has previously been noted that the sum of plus and the sum of minus differences (shown in the first two lines) must be equal. The reversal of signs as between the last two lines is in accordance with the fact that the larger the sum of differences (disregarding signs) the less the degree of correlation.

It is important to emphasize the point that in the use of state series

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The maximum possible sum of differences for a 20-item ordinal series is 200, and for 10 items, 50. Since there are two 10-item series in the decile-grade columns, the maximum possible sum of differences for these series is 100.

Comparable with these maximum series there are, for the specific differences, numerator elements in the correlation fraction of $158-100=+58$ and $92-100=-8$, of which the complementary difference is $+92$. The combined correlation fraction is thus $\frac{150}{200}$, and the index -75 per cent.

For the decile-grade differences the numerator elements are $78-50=+28$, and $44-50=-6$, of which the complementary difference is $+44$. The combined fraction is $\frac{72}{100}$, and the index -72 per cent.

The corresponding specific-displacement index for the 40-item area and density series (Table II) is -70 per cent.

After assignment of the decile-grades, the differences obtained are numerically as specific as by the specific-displacement method, but are for two or more pairs of 10-item series instead of for a single pair of longer series.

the elimination of extraneous factors is impossible, though the computations may sometimes be greatly improved by reducing the series to appropriate relative numbers. In physics the relation between degrees of heat and the expansion of a metal, for example, may possibly be

TABLE I

COMPUTATION OF THE INDEXES

	For absolute increase and population		*For per cent increase and population*		*For absolute increase and density*		*For per cent increase and density*	
	Largest figures first	Ordinals of one series reversed	Largest figures first	Ordinals of one series reversed	Largest figures first	Ordinals of one series reversed	Largest figures first	Ordinals of one series reversed
Sum of plus differences.	+142	+564	+343	+451	+269	+518	+379	+439
Sum of minus differences.	—142	—564	—343	—451	—269	—518	—379	—439
Combined sum.....	284	1,128	686	902	538	1,036	758	878
Subtract half the maximum possible sum.	600	600	600	600	600	600	600	600
Difference (+ or —).	—316	+528	— 86	+302	— 62	+436	+158	+278
Complement of difference for reversed series..............	..	— 72	..	—298	..	—164	..	—322
Algebraic sum of last two items..........	—388		—212		—226		—164	
Index (ratio of sum to 1200)............	+.32		+.18		+.19		+.14	

shown with extraneous influences safely out of consideration. But the term correlation—as it is coming to be used—is hardly appropriate for so definite and certain a connection. While the social sciences may easily provide better series than those for the 49 states (including the District of Columbia) above used, they never make it possible to approximate the conditions of the physical laboratory. Usage of the term correlation should perhaps recognize this difference—although the biologist may, from his middle ground, object.

In general, correlation is at best related to causation as collateral kin of a different blood mixture, though the difference due to admixture may be slight. A chief interest of correlation studies consists in showing comparatively slight connections and such relationships as persist through, though weakened by, the incidence of miscellaneous and extraneous and haphazard influences.

The irregularity of the absolute intervals between adjacent items of the pre-ordinal series naturally suggests itself as the principal objection to the elaborated use of ordinal methods. The illustrated series of Table II present great irregularity, which is conveniently expressed

TABLE II

ORDINAL AND RELATED SERIES FOR THE AREA AND DENSITY OF POPULATION OF THE 49 STATES (INCLUDING THE DISTRICT OF COLUMBIA) IN 1930

States (in order of area)	Area (square miles)	Difference in area from state next above	Ordinals for preceding differences	Cumulatives of ordinals for: Differences	Cumulatives of ordinals for: Areas*
Texas	265,896	....	....	....	....
California	158,297	107,599	1	1	1
Montana	146,997	11,300	5	6	3
New Mexico	122,634	24,363	2	8	6
Arizona	113,956	8,678	7	15	10
Nevada	110,690	3,266	15	30	15
Colorado	103,948	6,742	9	39	21
Wyoming	97,914	6,034	11	50	28
Oregon	96,699	1,215	27	77	36
Utah	84,990	11,709	4	81	45
Minnesota	84,682	308	43	124	55
Idaho	83,888	794	33	157	66
Kansas	82,158	1,730	24	181	78
South Dakota	77,615	4,543	12	193	91
Nebraska	77,520	95	46	239	105
North Dakota	70,837	6,683	10	249	120
Oklahoma	70,057	780	34	283	136
Missouri	69,420	637	37	320	153
Washington	69,127	293	44	364	171
Georgia	59,265	9,862	6	370	190
Florida	58,666	599	39	409	210
Michigan	57,980	686	36	445	231
Illinois	56,665	1,315	26	471	253
Iowa	56,147	518	40	511	276
Wisconsin	56,066	81	47	558	300
Arkansas	53,335	2,731	19	577	325
North Carolina	52,426	909	32	609	351
Alabama	51,998	428	42	651	378
New York	49,204	2,794	17	668	406
Louisiana	48,506	698	35	703	435
Mississippi	46,865	1,641	25	728	465
Pennsylvania	45,126	1,739	23	751	496
Virginia	42,627	2,499	21	772	528
Tennessee	42,022	605	38	810	561
Ohio	41,040	982	31	841	595
Kentucky	40,598	442	41	882	630
Indiana	36,354	4,244	13	895	666
Maine	33,040	3,314	14	909	703
South Carolina	30,989	2,051	22	931	741
West Virginia	24,170	6,819	8	939	780
Maryland	12,327	11,843	3	942	820
Vermont	9,564	2,763	18	960	861
New Hampshire	9,341	223	45	1,005	903
Massachusetts	8,266	1,075	30	1,035	946
New Jersey	8,224	42	48	1,083	990
Connecticut	4,965	3,259	16	1,099	1,035
Delaware	2,370	2,595	20	1,119	1,081
Rhode Island	1,248	1,122	29	1,148	1,128
District of Columbia	70	1,178	28	1,176	1,176
	3,026,789	265,826	1,176	....	....

* The ordinals cumulated are one less than for the number of states in order to match the number of differences.

by the differences between the items as arranged in the order of size.

The areas arranged in order of size, the corresponding differences in area, the ordinals for the differences, and cumulative ordinals for both series are shown in the first part of the table. The order of the differences does not conform to that of the areas, though there is evidently some tendency for the especially larger differences to be associated

TABLE II (*Continued*)

States (in the order of density of population)	Density of population (Number per square mile)	*Difference* in density from state next above	*Ordinals* for preceding differences	Cumulatives of ordinals for	
				Differences	Density*
District of Columbia	9,055.27	....	....	....	....
Rhode Island	650.88	8,404.39	1	1	1
Massachusetts	614.11	36.77	6	7	3
New Jersey	591.41	22.70	9	16	6
Connecticut	323.65	167.76	2	18	10
New York	255.83	67.82	3	21	15
Pennsylvania	213.43	42.40	5	26	21
Ohio	161.96	51.47	4	30	28
Illinois	134.66	27.30	8	38	36
Maryland	132.35	2.31	23	61	45
Delaware	100.58	31.77	7	68	55
Indiana	89.08	11.50	11	79	66
Michigan	83.52	5.56	14	93	78
West Virginia	71.54	11.98	10	103	91
Kentucky	64.40	7.14	13	*116*	*105*
Tennessee	62.27	2.13	24	140	120
North Carolina	60.47	1.80	25	165	136
Virginia	56.61	3.86	21	186	153
South Carolina	56.11	.70	37	223	171
Wisconsin	52.42	3.69	20	243	190
Missouri	52.28	.14	47	290	210
Alabama	50.80	1.39	20	310	231
New Hampshire	49.81	1.08	33	352	253
Georgia	49.08	.73	*35*	*387*	*276*
Iowa	44.01	5.07	17	404	300
Louisiana	43.33	.68	38½	442½	325
Mississippi	42.89	.44	42	484½	351
Vermont	37.69	5.20	15	499½	378
California	35.85	1.74	26	525½	406
Arkansas	34.77	1.09	32	557½	435
Oklahoma	34.20	.57	41	598½	465
Minnesota	30.28	3.92	19	617½	496
Florida	25.03	*5.25*	*18*	635½	528
Maine	24.14	.89	34	677½	561
Kansas	22.89	1.25	30	697½	595
Washington	22.62	.27	43	740½	630
Texas	21.91	.71	36	776½	666
Nebraska	17.78	4.13	18	794½	703
Colorado	9.96	7.82	12	806½	741
Oregon	9.80	.16	48	854½	780
North Dakota	9.61	.25	44	898½	820
South Dakota	8.93	.68	38½	937	861
Utah	5.98	2.95	22	959	903
Idaho	5.31	.67	40	999	946
Arizona	3.82	1.49	27	1,026	990
Montana	3.66	.16	46	1,072	1,035
New Mexico	3.45	.21	45	1,117	1,081
Wyoming	2.30	1.15	31	1,148	1,128
Nevada	.82	1.48	28	1,176	1,176
	....	....	1,176	....	....

* The ordinals cumulated are one less than for the number of states in order to match the number of differences.

with the especially large areas. If there were an exact correspondence, the cumulated ordinals for the differences would be identical with the cumulated ordinals for the areas. At the 24th item, however, the cumulated ordinal for differences is more than five-sixths greater than that for areas. *The importance of historical accident is suggested by* the position of the thirteen original states. No very close relationship of the size of the differences to the size of the states is to be expected.[1]

[1] *A complication in the details of the computation may result from there being several equal values*

The ordinal index of correlation between the two series, for area and differences in area respectively, is +20. The Pearson computation gives a coefficient of +58.

In the area series there is some small degree of (relative) concentration. There are 9 instances in the 50,000–60,000 class—more than in any other equal range. This naturally tends to cause rather small differences to be numerous in association with the middle ordinals of the area series.

Numerical data for density and differences in density of population are shown in the second part of the table. In this case the cumulative ordinals for the two series are closer together at the 24th than for the area series, that for differences being only one-third larger than that for density. There is a fairly consistent increase in the frequency of smaller differences in density with increasing sparsity of population.

Both these distributions are more regular than those for area. Consequently the ordinal and Pearsonian computations might be expected to yield results closer together. The ordinal index is +26 and the Pearson coefficient is +59.

Since the Pearson coefficient is alleged to understate the degree of correlation where the distribution is not rectilinear, it would seem that the ordinal index is weak.[1] This will perhaps be found to be largely a matter of the effect upon indexes of differences in implied weights for the extreme variations and for the closely placed items near the mode.

Critics of the use of ordinals are too much concerned with the uneven spacing of the items in the pre-ordinal series.[2] Such greater or less irregularity of intervals is largely due to the small number of instances that are likely to be used in ordinal series; and so far calls for nothing more than a warning against too much reliance on small numbers—which may be all there is to work with. The location of the greatest irregularity—that is, among extreme values—is of more specific sig-

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in a series. How this situation is handled is indicated by the use of duplicate ranks in Table II. The sum of the duplicate ranks, it should be noted, must be equal to that of the specific ordinals for which they are substituted. In this table, as in most other cases, duplicate ranks might have been avoided by carrying the basic items to further decimal places.

[1] Irregularity with regard to the intervals between adjacent items does not necessarily involve non-rectilinearity of distribution. But, especially if there is no very high degree of correlation, it may be presumed to do so.

[2] The allegation of an assumption by the "rank method" that adjacent items of the original series differ from each other by an equal amount is not worth answering. If the allegation be that regularity (of no matter what type and without regard to symmetry) is assumed, then the criticism acquires respectable standing. But this means merely that the number of items should be large enough to give a fair degree of regularity in distribution; or else that inferences should be based on indexes from more than one short series.

It should be remembered that whatever weakness ordinal analysis may have is in some degree also a constitutional weakness of medians and quartiles in whatever use; though the fact that the median is in the region of densest distribution helps it greatly.

nificance; and its effect on a correlation index is moderated by the ordinal method. Indeed, important advantage may properly be claimed for the ordinal index on this score, since extreme values are usually the least reliable. But this is a question of implied weights and a subject for later and separate consideration.

Duly analytical and inductive consideration of the results of its application, rather than the most refined mathematical study, will determine the degree of usefulness and the special field of usefulness of the ordinal index.

ON ANALYTICAL INTERPRETATION OF STRAW-VOTE SAMPLES[1]

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It is the purpose of this paper to bring together some of the more important theoretical considerations concerning the validity and significance of straw polls, and to present and discuss selected experimental analyses. From the point of view of the technical statistician, the essential problem involved in the use and interpretation of straw-vote data is a problem in sampling. The principal statistical operations useful in the analysis of straw-vote results are accordingly those which look to the criticism and rectification of the sample upon which the straw returns are based.

The straw poll inevitably involves sampling, and on three chief counts. Such a poll, to be of practical use, must be held in advance of the actual election; and therefore, even though it succeeded in covering every voter who subsequently participated in the actual election, sampling errors would arise because of changes in voting intentions. Such a poll must be based upon a selection from the qualified voters; and, even though it covered them perfectly, it would be only a "sample" of those voters who actually participated in the election. Such a poll, for obvious practical reasons, can not be a perfect report of the entire qualified electorate; and therefore sampling difficulties, in the ordinary sense of incomplete reporting, must arise.

Statistical theory suggests that the best sample to use in a case of this sort is a random sample—the term *random* being understood in the technical sense, and not in the loose sense frequently adopted by lazy or careless investigators who ignore or are unaware of the imperfections of the sampling processes which they use. The straw-vote problem is, unfortunately, not a simple case of random sampling; for the total "population" is not a homogeneous body, in that there are within the population several fairly distinct groups which presumably have different voting tendencies. In this respect, the problem is somewhat similar to that of commodity prices: in this problem, as in that problem, the sampling procedure must cover adequately each of the more important groups within the total population. Any such group may be fairly homogeneous within itself, and the ordinary method of random sampling can be used in making selections from that group. So far

[1] The bulk of the compilations and computations upon which this article is based were made under a grant of money from the Harvard University Committee on Research in the Social Sciences.

as selection from the entire population is concerned, however, some attention is needed to insure that each important group is reached to the proper extent, particularly in case the complete sample is not very large.

In the conduct of the typical straw poll, proper sampling in the theoretical sense is seldom used—perhaps it is not feasible. A well conducted straw poll will, however, give us information furnishing a test of the adequacy with which the poll has reached various important groups within the population. The groupings in which we have chief interest are those according to (1) political party or previous voting preference, (2) geographical location, (3) sex, (4) race or nationality, and (5) economic status. Few straw polls as actually conducted give us adequate information on all of these heads; but certain such polls give helpful information on the first two points. Thus the *Literary Digest* poll gives information as to past voting preference, and it is with the utilization of these facts in the interpretation of the results of the *Digest* poll that this article is mainly concerned. The *Digest* also classifies its data by states, and thereby enables us to make some allowance for geographical considerations. The *Digest* has at times in the past given some data on voting in particular cities, but there is no general basis for the study of this poll according to geographical divisions smaller than states. Upon the three other heads mentioned above the *Digest* publishes no systematic information in connection with its poll, although certain fragments of data have been made available with reference to some of these groupings.

The central operation in the present analytical interpretation of the *Digest* results consists in rectifying the figures so that they may be taken to apply to such a sample as would have been polled if each

TABLE I

ILLUSTRATION OF THE OPERATIONS IN RECTIFYING SAMPLE, CASE FOR ILLINOIS

Groups of 1928 voters	Actual data reported by *Digest* from 1932 poll, in issue of November 5:			Percentage distribution of straw returns to:		Estimated votes* cast for Hoover and Roosevelt in 1932:		
	For Hoover	For Roosevelt	Total	Hoover	Roosevelt	Total	Allocated, using straw percentages, to: Hoover	Roosevelt
Republican	63,202	46,326	109,528	57.7	42.3	1,592	918	674
Democrat	4,661	46,261	50,922	9.2	90.8	1,182	109	1,073
No vote	8,524	13,206	21,730	39.2	60.8	466	183	283
Total	76,387	105,793	182,170			3,240	1,210	2,030

* Thousands.

group, as determined by past preferences, had been proportionately covered.[1]

The arithmetical steps in this operation are illustrated in Table I. These steps include: computation, from the reporting *Digest* data, of the percentage distribution of 1928 Republican voters according to their indicated intentions for Hoover and for Roosevelt in 1932 (these percentages appear in the table as 57.7 and 42.3); computation of similar percentages of the 1928 Democratic voters, and similarly for those straw voters who did not report how they voted in 1928; the utilization of the percentages thus obtained to estimate the distribution of the surviving 1928 Republican voters between Hoover and Roosevelt in 1932 (these computations yield the items 918 and 674 in the table); a similar allocation, by the use of computed percentages, of the surviving 1928 Democratic voters, and of those voters who will appear at the polls in 1932 for the first time; the combining of the three elements of the estimated Hoover vote into a single figure (1210), and similarly for the three elements of the estimated Roosevelt vote (2030).

In making the allocation, an essential step was the estimation of the 1932 votes to be cast by each of the three groups—Republican, Democratic, and "no vote in 1928." The data on actual votes in 1928—showing those for Hoover, those for Smith, and the state total—were taken from the *Statistical Abstract*. We assumed that the Republican and Democratic totals for 1928 would each be reduced by 10 per cent in 1932. This rests upon the fact that a considerable fraction of the 1928 voters had died, had become disfranchised, or for other reasons would not vote in 1932. Naturally this percentage can be nothing better than an assumption, but it seems to fit very well the known facts. In regard to the "no vote" group, we have assumed that it would amount in 1932 to 15 per cent of the total 1928 vote. The basis for this assumption is somewhat different from the other, and the percentage assumed is different from that used in my 1928 investigation.[2] These assumptions lead to the items in the sixth column of the table, and it will be observed that the unit is one thousand votes.

Each of these estimated group totals is allocated to Hoover and Roosevelt as shown in the two right-hand columns of the table. The

[1] The first report which I made of this type of analysis was published in the *Wall Street Journal* for November 2, 1928. I am not aware whether this method, or a similar method, had been worked out earlier. Similar methods may have been in use for a long time; and, in any case, have recently come into wide general use. See for example the "party-to-party shift method" illustrated at page 122 of Claude E. Robinson's *Straw Votes*, Columbia University Press, 1932. His calculations, however, do not allocate the "no vote" group.

[2] I reported in 1928, *Wall Street Journal*, issue of November 2, that the 1928 vote was likely to increase heavily over that of 1924. Various reasons led to the assumption of a smaller increase in 1932. These reasons are set forth in my 1932 election forecast articles—*Wall Street Journal*, issues of October 29 and November 7, especially the former.

allocation is accomplished by using the percentages calculated from the straw poll. It will be understood that these final steps assume that those straw votes indicating 1928 Republican preferences form a good sample of the 1,592 thousand estimated Republican votes in 1932, and that similar inferences are made for the other two groups. Clearly, we have no evidence to support this assumption as to the validity of the group samples—our analysis has succeeded in correcting the general sample for its poor distribution as among the three groups, but it makes no progress in testing or correcting the specific sample for each group. No such progress can be made with the data available.

Computations exactly parallel to that shown in Table I were made for every state, and for every state an estimate was accordingly developed for the 1932 vote for Hoover and that for Roosevelt, corresponding to the 1,210 and the 2,030 of this table.

Various ways might be suggested for interpreting the end results of the operation shown in Table I. For example, we might divide the 1,210 into the 2,030, and obtain 1.68 as the indicated *odds* of Roosevelt over Hoover. Such a procedure is helpful in summarizing the evidence of the straw poll for the various states. It should be taken in connection with the known number of electors for each state, as it is in terms of electors that the outcome of the contest is actually decided.

In order to take account jointly of the indicated odds and the known number of electors for each state, we can use a concept analogous to "expectation" in the theory of chance. Using again the end results of Table I, we may say that the quotient of 2,030 divided by 3,240 (the sum of the estimated votes for Hoover and for Roosevelt) is the *probability* for Roosevelt to carry Illinois. This figure, .608, is a statistical measure of the probability of Roosevelt's victory in Illinois in the usual sense of the theory of chance. We note that the assumption is made that no third candidate of consequence can come forward for second place—on this basis, the outcome is a straight question as to whether Roosevelt leads Hoover or vice versa. This is the justification for confining the calculation of probability to the total of the Hoover and Roosevelt votes alone—it is plurality which elects and not majority. Having obtained this figure for the probability, we can calculate Roosevelt's electoral expectation for Illinois by multiplying this figure by the number of electors (29) giving 18.18. When we obtain similar figures for the electoral expectation in all of the states, they can be combined to yield a single electoral expectation for the entire United States. This item, 340.67, is more than half of the total number of electors (531), and therefore indicated probable victory for Roosevelt. In fact, the ratio (64.2) of this combined electoral expectation to 531 is a

group, as determined by past preferences, had been proportionately covered.[1]

The arithmetical steps in this operation are illustrated in Table I. These steps include: computation, from the reporting *Digest* data, of the percentage distribution of 1928 Republican voters according to their indicated intentions for Hoover and for Roosevelt in 1932 (these percentages appear in the table as 57.7 and 42.3); computation of similar percentages of the 1928 Democratic voters, and similarly for those straw voters who did not report how they voted in 1928; the utilization of the percentages thus obtained to estimate the distribution of the surviving 1928 Republican voters between Hoover and Roosevelt in 1932 (these computations yield the items 918 and 674 in the table); a similar allocation, by the use of computed percentages, of the surviving 1928 Democratic voters, and of those voters who will appear at the polls in 1932 for the first time; the combining of the three elements of the estimated Hoover vote into a single figure (1210), and similarly for the three elements of the estimated Roosevelt vote (2030).

In making the allocation, an essential step was the estimation of the 1932 votes to be cast by each of the three groups—Republican, Democratic, and "no vote in 1928." The data on actual votes in 1928—showing those for Hoover, those for Smith, and the state total—were taken from the *Statistical Abstract*. We assumed that the Republican and Democratic totals for 1928 would each be reduced by 10 per cent in 1932. This rests upon the fact that a considerable fraction of the 1928 voters had died, had become disfranchised, or for other reasons would not vote in 1932. Naturally this percentage can be nothing better than an assumption, but it seems to fit very well the known facts. In regard to the "no vote" group, we have assumed that it would amount in 1932 to 15 per cent of the total 1928 vote. The basis for this assumption is somewhat different from the other, and the percentage assumed is different from that used in my 1928 investigation.[2] These assumptions lead to the items in the sixth column of the table, and it will be observed that the unit is one thousand votes.

Each of these estimated group totals is allocated to Hoover and Roosevelt as shown in the two right-hand columns of the table. The

[1] The first report which I made of this type of analysis was published in the *Wall Street Journal* for November 2, 1928. I am not aware whether this method, or a similar method, had been worked out earlier. Similar methods may have been in use for a long time; and, in any case, have recently come into wide general use. See for example the "party-to-party shift method" illustrated at page 122 of Claude E. Robinson's *Straw Votes*, Columbia University Press, 1932. His calculations, however, do not allocate the "no vote" group.

[2] I reported in 1928, *Wall Street Journal*, issue of November 2, that the 1928 vote was likely to increase heavily over that of 1924. Various reasons led to the assumption of a smaller increase in 1932. These reasons are set forth in my 1932 election forecast articles—*Wall Street Journal*, issues of October 29 and November 7, especially the former.

allocation is accomplished by using the percentages calculated from the straw poll. It will be understood that these final steps assume that those straw votes indicating 1928 Republican preferences form a good sample of the 1,592 thousand estimated Republican votes in 1932, and that similar inferences are made for the other two groups. Clearly, we have no evidence to support this assumption as to the validity of the group samples—our analysis has succeeded in correcting the general sample for its poor distribution as among the three groups, but it makes no progress in testing or correcting the specific sample for each group. No such progress can be made with the data available.

Computations exactly parallel to that shown in Table I were made for every state, and for every state an estimate was accordingly developed for the 1932 vote for Hoover and that for Roosevelt, corresponding to the 1,210 and the 2,030 of this table.

Various ways might be suggested for interpreting the end results of the operation shown in Table I. For example, we might divide the 1,210 into the 2,030, and obtain 1.68 as the indicated *odds* of Roosevelt over Hoover. Such a procedure is helpful in summarizing the evidence of the straw poll for the various states. It should be taken in connection with the known number of electors for each state, as it is in terms of electors that the outcome of the contest is actually decided.

In order to take account jointly of the indicated odds and the known number of electors for each state, we can use a concept analogous to "expectation" in the theory of chance. Using again the end results of Table I, we may say that the quotient of 2,030 divided by 3,240 (the sum of the estimated votes for Hoover and for Roosevelt) is the *probability* for Roosevelt to carry Illinois. This figure, .608, is a statistical measure of the probability of Roosevelt's victory in Illinois in the usual sense of the theory of chance. We note that the assumption is made that no third candidate of consequence can come forward for second place—on this basis, the outcome is a straight question as to whether Roosevelt leads Hoover or vice versa. This is the justification for confining the calculation of probability to the total of the Hoover and Roosevelt votes alone—it is plurality which elects and not majority. Having obtained this figure for the probability, we can calculate Roosevelt's electoral expectation for Illinois by multiplying this figure by the number of electors (29) giving 18.18. When we obtain similar figures for the electoral expectation in all of the states, they can be combined to yield a single electoral expectation for the entire United States. This item, 340.67, is more than half of the total number of electors (531), and therefore indicated probable victory for Roosevelt. In fact, the ratio (64.2) of this combined electoral expectation to 531 is a

general measure of the probability of Roosevelt's victory in the election as a whole.

In carrying out these computations, no specific allowance has been made for the vote of the third parties. At the time the 1932 straw poll was completed it was believed that one of the minor parties would obtain a very large vote in the election, and it was thought possible that the vote of this minor party might come predominantly from one of the old parties and thus decide the outcome in certain closely contested states. With the data of the straw poll as published, there appears no sound quantitative means of allowing for the third party vote; but, in studying the odds for a particular state, the indicated odds can be reduced arbitrarily to make some allowance for the third party vote. Were the indicated odds close, this might throw the state into the doubtful column. It is also possible that, for certain closely contested states, the assumption that the "no vote" group will run 15 per cent of the 1928 total may control the indicated odds—in such states it is conservative practice to use a different percentage assumption for the "no vote" group, with a view to throwing the state toward the less favored candidate.

It is obviously desirable to obtain during the progress of the straw poll whatever indications it may afford of shifts in the intentions of voters during the campaign. It has sometimes been contended that large-scale straw polls, such as that of the *Literary Digest*, should be regarded as pertaining to a point of time.[1] There can be little doubt that, if all or most of the blanks for the *Literary Digest* poll are sent out at about the same time, the bulk of the returns do reflect sentiment at a point—or during a very brief interval—of time. The tabulated returns as presented in the issues of the *Literary Digest*, however, suggest that the actual submission of the votes takes place over a considerable period—we are assuming, of course, that the *Digest* is not one of those sponsors of straw polls practicing the withholding of returns in order to sustain interest in the poll. Examination of the tabulated returns for a particular state is likely to show that the great bulk of the returns is tabulated in the issue of a single week, but considerable fractions of the total appear to be tabulated also in one or more other weeks. It has seemed likely that, in any case in which the vote tabulated in one of these additional weeks is an important fraction of the state's total in the entire straw poll, we might regard that additional week as a separate sample yielding a measure of voting preferences at another time than the time to which the bulk of state's straw votes pertain.

[1] For example, Robinson's *Straw Votes*, at page 108 and 109.

We have carried through an analysis on this basis for all of the states. In each state we have compiled the votes pertaining to each specific issue of the magazine.[1] With these figures at hand, we have selected for each state those weeks in which the number of straw votes in each of our three groups of 1928 voters amounted to at least 10 per cent of the corresponding totals for that state in the entire straw poll (as tabulated finally in the issue of November 5). Strictly, there were a few cases in which we included a week for which the figure did not reach quite to 10 per cent, but these were infrequent exceptions. For the weeks thus selected, and using the data pertaining specifically to those weeks, we have carried through completely the type of computations shown in Table I. A summary of all the results, in somewhat briefer form than in Table I, appears in Table II.

Some idea of the time variations in indicated preferences can be obtained, for each state, from the percentages in the first three columns. In studying these figures, of course, the summary items marked "total," which are based upon the complete straw poll, should be excluded. In certain of the states, only one week is presented separately from the "total" figures; and for these states no real evidences of time variation can be found. For the other states, the most significant comparisons are between data for October 29 and for some earlier week. Where comparison of these two weeks shows a definite or considerable change in one direction for each of the three groups of 1928 voters, there is presumptive evidence of some shift in preference during the progress of the poll. Naturally any indications of this sort, resting upon differences between the two percentages applying to the two weeks, can only be significant if the difference between the two items is sufficiently large so that it can not be charged to errors of sampling. Because of the way in which the data are compiled and published, we can not calculate the probable error of any of these percentages; even if we could assume that random sampling pertained to the straw-vote sample in each of the three groups.

We give in column 5 of the table the percentage of the combined Hoover and Roosevelt votes actually obtained by Roosevelt in the election.[2] These percentages in column 5 are to be compared with the

[1] The tables in the magazine give, in fact, cumulative figures to date. In order to get the figures for the particular week, it is therefore necessary to take first differences of the data as published. In all references to these data we shall designate them by the date of the issue in which the tabulations appear; actually, of course, the votes pertain to an earlier date. How much earlier this date is depends upon the time needed for compilation and publication, as well as the time during which the votes are in the mail. In 1928 the *Digest* tabulations were headed by a statement indicating the date through which the published figures had been compiled, but this practice was not followed in 1932.

[2] These percentages are calculated from data tabulated in *The New York Sun*, issue of December 24, 1932.

TABLE II

SUMMARY OF FIGURES DERIVED FROM *DIGEST* DATA FOR SELECTED WEEKS, FOR EACH STATE

State name, and number of 1932 electors	Part of straw poll on which based (a)	Indicated per cent for Roosevelt among straw voters who: Voted Rep., 1928	Voted Dem., 1928	Did not vote 1928	Roosevelt per cent of Hoover-Roosevelt votes, 1932: Estimated	Actual	Electoral "expectation" for Roosevelt, based on: First significant week (b)	Last significant week (c)	Total straw poll
Alabama 11	Oct. 8	43.7	97.7	82.6	73.1		8.01		
	15	51.7	96.2	85.4	77.0	85.7			
	20	52.5	96.4	84.8	76.5			8.42	
	Total	50.3	96.6	84.0	75.6				8.32
Arizona 3	Oct. 15	44.8	93.1	68.7	65.7	68.8	1.07		
	Total	44.1	92.2	69.7	65.1			(c) 1.05	1.05
Arkansas 9	Oct. 15	44.0	98.0	83.3	77.9	87.0	7.01		
	Total	41.6	97.9	82.8	77.7			(c) 6.99	6.99
California 22	Oct. 8	58.0	93.9	71.8	71.0		15.02		
	15	53.6	93.1	65.3	66.0				
	20	48.3	92.2	60.5	62.9	60.9		13.84	
	Total	53.6	92.9	66.5	67.0				14.74
Colorado 6	Oct. 8	38.2	92.0	67.7	58.3	57.0	3.50		
	15	35.3	91.1	49.5	53.4			3.14	
	Total	36.7	91.4	59.2	55.5				3.33
Connecticut 8	Oct. 1	20.7	81.4	42.3	48.4		3.87		
	8	20.7	80.3	42.6	49.6	49.5			
	15	20.0	85.6	41.2	49.3			3.94	
	Total	20.3	85.4	41.6	49.1				3.93
Delaware 3	Oct. 15	31.0	84.6	57.2	50.7		1.52		
	Total	30.7	85.1	55.5	50.2	48.8		(c) 1.51	1.51
Florida 7	Oct. 22	48.2	94.1	72.8	68.0	75.0	4.70		
	20	47.0	93.1	68.6	67.0			4.69	
	Total	47.0	93.8	72.0	67.7				4.74
Georgia 12	Oct. 15	94.0	98.0	87.3	86.8	92.2	10.42		
	20	92.3	96.9	86.2	85.6			10.27	
	Total	92.5	97.6	86.6	86.2				10.34
Idaho 4	Oct. 15	45.3	91.4	65.2	61.0		2.48		
	Total	45.1	91.3	64.5	61.6	60.6		(c) 2.46	2.46
Illinois 29	Oct. 8	47.8	92.0	69.0	67.2		19.48		
	15	41.0	91.0	60.6	62.5				
	20	40.1	88.8	55.4	60.1	56.8		17.42	
	Total	42.3	90.8	60.8	62.7				18.18
Indiana 14	Oct. 8	44.4	92.2	68.9	64.2		8.09		
	15	35.4	91.0	58.4	57.6				
	20	34.8	88.0	55.7	56.3	56.0		7.83	
	Total	36.6	90.6	59.8	58.3				8.16
Iowa 11	Oct. 15	44.7	92.0	66.7	62.2		6.81		
	20	43.0	91.6	62.2	61.4	59.1		6.75	
	Total	44.3	91.9	66.3	62.0				6.82
Kansas 9	Oct. 15	39.5	91.7	59.9	55.4		4.99		
	20	38.5	91.6	58.2	54.4			4.90	
	Total	39.4	91.6	59.2	55.1	54.9			4.96
Kentucky 11	Oct. 15	35.6	93.9	66.0	60.2	59.6	6.62		
	20	42.5	93.8	67.1	63.6			7.03	
	Total	37.0	93.7	66.2	60.9				6.70
Louisiana 10	Oct. 15	53.7	93.8	81.7	84.0		8.40		
	20	57.6	94.2	79.5	81.7	92.9		8.47	
	Total	54.7	94.0	81.2	84.2				8.42
Maine 5	Oct. 1	20.6	90.9	50.2	47.1		2.36		
	8	28.6	91.3	40.2	48.2				
	15	25.3	90.2	41.4	44.9	43.6		2.24	
	Total	26.1	90.3	44.3	45.8				2.29

TABLE II—*Continued*

State name, and number of 1932 electors	Part of straw poll on which based (a)	Indicated per cent for Roosevelt among straw voters who: Voted Rep., 1928	Voted Dem., 1928	Did not vote 1928	Roosevelt per cent of Hoover Roosevelt votes, 1932: Estimated	Actual	Electoral "expectation" for Roosevelt, based on: First significant week (b)	Last significant week (c)	Total straw poll
Maryland 8	Oct. 22	44 0	02 0	70.0	00.2	63.1	5 30	(c) 5.25	5.25
	Total	44.3	02.8	00.0	05.6				
Massachusetts 17	Oct. 1	20.8	82.2	44.7	50.8		0.60		
	8	18.8	85.2	44 8	51.2	52.1			
	15	17.2	83.7	30.7	48.8			8.04	
	20	20.2	77.4	35:7	47.3				8.43
	Total	18.3	83.2	40.3	40.6				
Michigan 19	Oct. 15	40.9	03.7	01.5	00.7		11.53	11.21	
	20	46.0	03.2	58 8	50.0	54.1			11.38
	Total	46.1	03.4	00.2	50.0				
Minnesota 11	Oct. 22	44.7	04.2	04.5	05.1		7.10	0.83	
	20	30.8	03.8	01.8	02.1	02.9			7.08
	Total	43.6	04.0	03.7	04.4				
Mississippi 9	Oct. 8	00 3	07.0	02.5	01.4	00.4	8.23		
	15	57.2	08.0	80.9	01.0			7.77	
	20	62.0	04.7	80.8	80.3				8.12
	Total	50.5	07.0	88.0	00.2				
Missouri 15	Oct. 22	40.0	04.8	07.7	05.2		0.78	0.00	
	20	41.6	03.2	03.8	04.4	04.5			0.75
	Total	40.8	04.5	07.1	05.0				
Montana 4	Oct. 8	43.2	02.6	08.8	04.2		2.57		
	15	40.0	01.5	50.7	01.2			2.60	
	20	41.0	01.0	02.8	02.5				2.48
	Total	41.4	01.7	04.3	02.3	02.0			
Nebraska 7	Oct. 15	48.0	02 0	07.6	06.0		4.55	4.44	
	20	45.4	03.0	65.5	63.4				4.51
	Total	48.2	02.3	00.5	04.4	04.1			
Nevada 3	Oct. 15	53 5	04 1	74.8	71.2	00.4	2.14	2.20	
	20	58.8	02.0	74.0	73.4				2.15
	Total	54.5	03.5	71.3	71.5				
New Hampshire 4	Oct. 8	23.7	89.1	47.7	40.7		1.00	1.07	
	15	22.0	80.4	43.0	40.3	40.3			1.07
	Total	22.7	88.8	46.6	40.3				
New Jersey 16	Oct. 1	30.0	88.0	50.0	53.2		8.51		
	8	20.0	88.0	49.3	52.4			8.10	
	15	27.4	80.0	46.4	51.0	51.0			8.20
	Total	28.4	88.5	48.0	51.6				
New Mexico 3	Oct. 15	37.0	03.4	02.7	00.0	03.7	1.83	1.72	1.81
	20	35.1	88.3	50.6	57 2				
	Total	37.7	02.7	01.7	00.3				
New York 47	Oct. 1	20.5	87.3	54.0	57.2	50.7	20.80		
	8	32.0	88 3	58 3	50 7			27.08	
	15	32.5	85 7	52.2	57.0				27.20
	Total	31.2	87.1	54.0	58.0				
North Carolina 13	Oct. 22	34.7	95.0	77.0	04.3		8.30	8.00	
	20	40.2	95.7	70.0	00.9	70.5			8.40
	Total	35.5	95.8	77 0	04.0				
North Dakota 4	Oct. 15	51.0	02 8	07.6	00 0	71.4	2.80	2.70	
	20	50.7	04 5	00.3	00.8				2.70
	Total	51.5	03.0	00.0	00.7				
Ohio 26	Oct. 8	45.0	02.4	05.7	02 0		10.28		
	15	41.4	01.1	50.8	58.5			14.40	
	20	37.2	80.1	55.0	55.4	61.5			15.13
	Total	40.0	90.0	58.1	58.2				

TABLE II—*Continued*

State name, and number of 1932 electors	Part of straw poll on which based (a)	Indicated per cent for Roosevelt among straw voters who: Voted Rep., 1928	Voted Dem., 1928	Did not vote 1928	Roosevelt per cent of Hoover-Roosevelt votes, 1932: Estimated	Actual	Electoral "expectation" for Roosevelt, based on: First significant week (b)	Last significant week (c)	Total straw poll
Oklahoma	Oct. 22	47.6	93.0	69.6	61.8	73.3	7.13		
11	Total	47.1	93.5	69.5	61.5			(c) 7.10	7.10
Oregon	Oct. 15	51.6	93.0	65.3	67.1		3.36		
5	20	48.9	92.0	62.8	61.0	61.1		3.20	
	Total	52.6	92.0	64.0	60.2				3.31
Pennsylvania	Sept. 24	40.0	90.5	63.7	58.7	47.2	21.3		
36	Oct. 8	48.4	92.0	61.7	63.8				
	15	43.8	92.7	57.3	60.0			21.60	
	Total	44.5	92.2	60.2	60.7				21.85
Rhode Island	Oct. 8	25.0	92.0	53.1	56.0	56.0	2.24		
4	15	24.1	89.2	48.6	55.6			2.22	
	Total	24.8	90.1	49.2	56.4				2.26
South Carolina	Oct. 8	61.9	99.0	87.1	93.1		7.45		
8	15	40.7	97.4	89.5	93.6	98.0		7.49	
	Total	51.4	99.0	89.0	97.5				7.48
South Dakota	Oct. 15	48.3	90.6	62.9	61.7	64.0	2.59		
4	20	48.8	93.5	60.8	65.6			2.62	
	Total	47.7	90.8	62.9	61.4				2.58
Tennessee	Oct. 22	37.9	95.1	74.1	65.7		7.23		
11	Total	38.2	94.8	74.8	65.8	67.2		(c) 7.21	7.24
Texas	Oct. 22	62.1	90.4	84.1	70.3	88.0	18.21		
23	Total	62.1	90.3	82.2	70.1			(c) 18.19	18.19
Utah	Oct. 15	45.8	93.2	63.3	67.0		2.68		
4	20	45.2	92.9	68.4	67.4			2.70	
	Total	45.4	92.9	63.7	66.8	57.0			2.67
Vermont	Oct. 15	23.8	92.2	41.5	45.7		1.37		
3	Total	23.7	91.7	42.1	45.6	41.6		(c) 1.37	1.37
Virginia	Oct. 22	41.4	95.1	75.8	67.4		7.41		
11	Total	41.4	95.3	75.9	67.6	69.5		(c) 7.44	7.44
Washington	Oct. 22	52.6	93.2	68.2	65.8		5.20		
8	20	50.8	92.5	64.1	63.9	62.0		5.11	
	Total	52.2	93.0	67.8	65.6				5.25
West Virginia	Sept. 24	30.8	91.0	59.8	57.0	55.1	4.03		
8	Oct. 1	31.6	93.8	62.4	61.1				
	8	38.7	91.0	69.6	64.4				
	15	38.2	92.8	62.3	62.5			5.00	
	Total	37.1	92.8	63.9	62.2				4.98
Wisconsin	Oct. 8	53.2	95.0	69.6	71.8		8.62		
12	15	52.7	95.2	69.7	71.7				
	20	52.3	95.2	69.6	71.4			8.57	
	Total	52.2	95.0	69.5	71.3	67.0			8.60
Wyoming	Oct. 15	42.3	86.4	63.2	58.8		1.70		
3	Total	40.9	87.7	62.5	58.3	58.0		(c) 1.75	1.75
United States							315.75	310.12	310.67

(a) Date refers to issue of magazine in which the data appear.
(b) First week having about 10 per cent, at least, of total straw vote.
(c) Last week having about 10 per cent of total straw vote. In column 7 the "total" item is repeated for those states having no late week.

corresponding estimates from the straw poll shown in column 4, and we have placed the item of column 5 opposite that item of column 4 which nearest approaches it, for each state.

Examination of columns 4 and 5 together gives at first an impression that no drift of sentiment was reflected by the successive weeks. When we confine our attention to the larger states (those with ten or more electors) we find somewhat different indications. Thus for California, Illinois, Indiana, Iowa, Louisiana, Michigan, Minnesota, Missouri, New Jersey, North Carolina, Ohio, and Wisconsin, the more recent weeks clearly reflect more accurately the probable outcome. For Alabama, Kentucky, Massachusetts, and Pennsylvania the earliest week (or a very early week) gave the best indication. The case of New York is exceptional: the best indication was given for October 1, but nearly as good an indication was given for October 15. These indications, for the larger states, unmistakably suggest that the later weeks in the straw voting gave a more accurate prediction for the specific state. For any one state, a tendency of this sort could be charged to errors of sampling; but, when the large majority of the major states show indications of the same sort, the results are mutually confirmatory. In making these tests the "last week" is usually that of October 29, but is earlier for certain states. There does not appear any reason for insisting that the same week be used as the "last week" for all states.

The evidences thus derived from Table II strongly suggest that a careful examination of the actual *Digest* poll does afford a measure of drift in sentiment. Despite the fact that the great bulk of the straw votes was submitted at about the same time, enough were submitted subsequently to form a considerable separate sample. If the skeptic still insists that the entire straw poll pertained to a single instant of time, we may then turn about and draw much satisfaction from the fact that the percentages of column 4 change only moderately from week to week for a particular state. The general stability of these percentages strengthens our faith in the goodness of the sample. In those states where large week-to-week shifts occurred a possible explanation is that different parts of the state were covered at different times during the poll; and, of course, this possibility exists even for those states where changes were not large. On this point, again, the general consistency of the indications for the larger states favors setting aside the "technical" explanation of the observed results.

If we compare, for each state, the "total" item of column 4 with the item of column 5 of Table II, we have a test of the precision of the straw poll—with the sample rectified according to the method of Table I. Except for a few states, there is surprising agreement between the

percentages thus indicated; and, although we have no certain basis for judgment, roughly satisfactory explanations suggest themselves in the case of each of the exceptional states. If it is desirable to summarize these comparisons for the entire United States, appropriate weights should be applied to allow for the differences in the number of electors. Conceivably we might in this way get a square root of the mean weighted squared discrepancy between the "total" item of column 4 and the corresponding item of column 5. This computation has not been carried out, because there is some doubt as to how the available accuracy of straw-poll predictions should be measured; and the present suggestion has not been sufficiently tested to warrant its adoption.[1] The last three columns of the table give the electoral expectation for each state based upon the early week, the late week, and the total straw poll. Addition of the 48 items in any one of these 3 columns gives the total electoral expectation for Roosevelt for the United States, based upon the early straw votes, or the late straw votes, or all of them. The fact that, in making this total, a given week may be called early for one state and late for another does not necessarily spoil the method—the campaign may progress differently in different states; and, in any case, we are talking about different portions of the straw poll. Each of these three totals is an estimate of the total electoral vote for Roosevelt, and the question then arises why these estimates are so wide of the mark when the accord between the percentages of column 4 and those of column 5 appeared so close (actually Roosevelt obtained 472 electors). The discrepancy may be due in part to the general underestimating of the Roosevelt percentage in specific states, although Table II gives little evidence of this. A more probable explanation is that the treatment of the percentages for individual states as though they were measures of "probability" is false, and this view is supported by the idea that much less than 100 per cent indicated for Roosevelt would in practical politics be accepted as "certainty." Furthermore, disregarding the fact that the electoral expectation is grossly underestimated, it appears that the late estimate is poorer than the early estimate. The late estimate does indeed indicate a slight drift toward Hoover during the progress of the poll; but, with both the early and the late estimates so very wide of the mark, it is doubtful if this variation is significant.

We have in the above analysis shown how the 1932 *Digest* sample can be rectified to allow for imperfect coverage of the 1928 groups, and it is

[1] Specific suggestions for testing the accuracy of straw polls are given in Robinson's *Straw Votes*, beginning at page 57.

fairly certain that the resulting indications of the Roosevelt percentage plurality for specific states are more accurate than indications which might have been calculated from the unadjusted tabulations. We have brought out some evidences that there was a drift in sentiment during the poll, and that the poll itself gives a partial means of measuring this drift; but, although similar study of the 1928 straw poll points in the same direction, there is still a possibility that these indicated drifts are illusory. In any case, the present study strongly suggests that a moderate change in the conduct of the poll would facilitate the study of drifts. We have suggested the calculation of a figure designated the "electoral expectation," but the results of this computation as summarized for the entire United States are found so at variance with the actual outcome as to cast doubt upon the theoretical validity of the concept. It will be observed that the entire analysis presented herewith takes off from a knowledge of the previous voting preferences of the individual straw voters—to test and interpret the 1932 poll we must have data on how the straw voters cast their ballots in the 1928 election.[1] If we are given no data as to the previous voting preference little progress can be made in testing or rectifying the straw-poll sample. For example, in the case of the *Literary Digest* polls on prohibition, rectification of the sample is impossible.[2] This suggests that in the conduct of such a poll great care should be taken to secure full information about previous voting preferences; and we may suggest also that further details about other sorts of groupings, as those discussed above (page 153) would be desirable, if such information could be obtained without discouraging the submission of straw ballots.

[1] Incomplete evidence of this sort is helpful though not sufficient—in my 1928 *Wall Street Journal* article this analysis was carried through, but it was imperfect because the facts concerning the 1924 LaFollette voters were not given. This difficulty is commented upon by Robinson in *Straw Votes*, but I think he is too stringent in his conclusion.

[2] Professor W. F. Willcox examined such polls in this *Journal*, September, 1931, page 243.

THE ANALYSIS OF VARIANCE IN A "2×s" TABLE WITH DISPROPORTIONATE FREQUENCIES

By A. E. Brandt, *Iowa State College*

The method of the analysis of variance is commonly used by the biometrician to answer one of the following questions. First, is the material homogeneous, that is, is it safe to assume that the given samples have been drawn from the same population? Second, what is the variance of this population? Other forms of the same questions are: Do the samples differ significantly, that is, is the variance between classes significantly different from the variance within classes? and What is the experimental error?

This method originated with Dr. R. A. Fisher, Chief Statistician, Rothamsted Experimental Station, Harpenden, England. Since no rigorous mathematical definition has been given for the method, it is not accepted by some of those interested primarily in the mathematics of statistics. Nevertheless, it has proved to be such a powerful and facile tool for the reduction of experimental data that it is being used rather generally in the various fields of biology.

As yet this method has not been presented completely in a single paper but has appeared in part from time to time as a tool in the analysis of various problems. Irwin (1931) has presented a number of the theorems involved in the analysis of variance but they are confined to the simple case of one individual in each classification. In the selected bibliography on analysis of variance at the end of this paper are listed the references which were used freely in preparing the basis for the material presented herein.

The analysis of variance, then, is simply a process by which a number of independent estimates of a variance are made (in homogeneous material) or estimates of a number of variances are made (in non-homogeneous material) and by which the significance of the differences between these estimates is determined. The number of estimates to be made depends upon the number of classes and sub-classes or groups into which the observations are divided. In the simple case of s classes containing k_p individuals each, three estimates of variance may be made. These are total variance, variance within classes and variance between classes. These estimates are based on the total sum of squares of deviations from the sample mean and two partitions of this total together with their respective numbers of degrees of freedom. The

portion called the sum of squares within classes is the sum of the squares of the deviations of individual observations from their class means and the remainder, called the between class sum of squares, is the sum of the squares of the deviations of the class means from the sample mean, each multiplied by the number (k_p) in the class. Thus, if X be the continuous variable, $\overline{X}$ the sample mean, and $\overline{X}_p$ a class mean, Table I contains a summary of the above relations with the appropriate number of degrees of freedom in each case.

TABLE I

	Degrees of freedom	Sums of squares	Mean squares
Between classes..............	$s-1$	$\Sigma[k_p(\overline{X}_p-\overline{X})^2]$	$\dfrac{\Sigma[k_p(\overline{X}_p-\overline{X})^2]}{s-1}$
Within classes...............	$n-s$	$\Sigma(X_i-\overline{X}_p)^2$	$\dfrac{\Sigma(X_i-\overline{X}_p)^2}{n-s}$
Total....................	$n-1$	$\Sigma(X_i-\overline{X})^2$	$\dfrac{\Sigma(X_i-\overline{X})^2}{n-1}$

Now if each of the s classes be divided into two sub-classes, a fourth estimate of variance may be made based on the sum of the squares of the deviations of the two 2-way means from the sample mean and the appropriate number of degrees of freedom. The sums of squares for between sub-classes, between classes and within classes now do not add to the total sum of squares. This discrepancy is the sum of squares due to interaction between the means of the various sub-classes. This sum of squares together with the proper number of degrees of freedom is the basis for a fifth estimate of variance.

The theory so far is based on the same frequency in each sub-class. Most biological data have been gathered without an adequate knowledge of or without proper regard for this method. Equal cell frequencies are frequently physically impossible to obtain as, for instance, in a study of the effects of sex and litter size on the birth weights of pigs. Frequently, also, experimental units are lost during the experimental period. Thus, it is easy to understand that the ideal of an equal number in each sub-group or classification is rarely realized. Certain generalizations, therefore, are necessary so that the method can be extended to general biological use.

Given n individuals, each characterized by an independent value of the continuous variable X, which can be arranged according to a certain quality in s classes and according to another in two sub-classes, the necessary information concerning them may be summarized in a $2\times s$ table as in Table II (s in this case being 3).

TABLE II

n_{11} ΣX_{11} $\bar{X}_{11}$ $\Sigma(X_{11})^2$ $(\Sigma X_{11})^2 \div n_{11}$ $\Sigma(X_{11}-\bar{X}_{11})^2$	n_{12} ΣX_{12} $\bar{X}_{12}$ $\Sigma(X_{12})^2$ $(\Sigma X_{12})^2 \div n_{12}$ $\Sigma(X_{12}-\bar{X}_{12})^2$	n_{1s} ΣX_{1s} $\bar{X}_{1s}$ $\Sigma(X_{1s})^2$ $(\Sigma X_{1s})^2 \div n_{1s}$ $\Sigma(X_{1s}-\bar{X}_{1s})^2$	$n_{1.}$ $\Sigma X_{1.}$ $\bar{X}_{1.}$ $\Sigma(X_{1.})^2$ $(\Sigma X_{1.})^2 \div n_{1.}$ $\Sigma(X_{1.}-\bar{X}_{1.})^2$
n_{21} ΣX_{21} $\bar{X}_{21}$ $\Sigma(X_{21})^2$ $(\Sigma X_{21})^2 \div n_{21}$ $\Sigma(X_{21}-\bar{X}_{21})^2$	n_{22} ΣX_{22} $\bar{X}_{22}$ $\Sigma(X_{22})^2$ $(\Sigma X_{22})^2 \div n_{22}$ $\Sigma(X_{22}-\bar{X}_{22})^2$	n_{2s} ΣX_{2s} $\bar{X}_{2s}$ $\Sigma(X_{2s})^2$ $(\Sigma X_{2s})^2 \div n_{2s}$ $\Sigma(X_{2s}-\bar{X}_{2s})^2$	$n_{2.}$ $\Sigma X_{2.}$ $\bar{X}_{2.}$ $\Sigma(X_{2.})^2$ $(\Sigma X_{2.})^2 \div n_{2.}$ $\Sigma(X_{2.}-\bar{X}_{2.})^2$
$n_{.1}$ $\Sigma X_{.1}$ $\bar{X}_{.1}$ $\Sigma(X_{.1})^2$ $(\Sigma X_{.1})^2 \div n_{.1}$ $\Sigma(X_{.1}-\bar{X}_{.1})^2$	$n_{.2}$ $\Sigma X_{.2}$ $\bar{X}_{.2}$ $\Sigma(X_{.2})^2$ $(\Sigma X_{.2})^2 \div n_{.2}$ $\Sigma(X_{.2}-\bar{X}_{.2})^2$	$n_{.s}$ $\Sigma X_{.s}$ $\bar{X}_{.s}$ $\Sigma(X_{.s})^2$ $(\Sigma X_{.s})^2 \div n_{.s}$ $\Sigma(X_{.s}-\bar{X}_{.s})^2$	n ΣX $\bar{X}$ ΣX^2 $(\Sigma X)^2 \div n$ $\Sigma(X-\bar{X})^2$

Of the six entries in each cell, the first is the number of individuals falling in that category, the second is the sum of the observations on those individuals, the third is the mean, the fourth is the sum of the squares of the observations, the fifth is the square of sum of the observations divided by the number, and the sixth is the sum of the squares of the deviations from the mean. The last entry is found by subtracting the fifth from the fourth. The double subscript is used to designate row and column, the first number indicating the row and the second the column. The dots are used to designate border values.

For this discussion, $2 \times s$ tables will be classified on the basis of cell frequency. In Case 1 the interior cell frequencies are identical. In Case 2 the frequencies in the 2-way sub-classes for each s-way class are in the same ratio as the frequencies in the 2-way border, that is,

$$\frac{n_{1j}}{n_{2j}} = \frac{n_{1.}}{n_{2.}} = K \text{ (K positive).}$$

In Case 3 the 2-way sub-class frequencies are not in the same ratio as the 2-way border frequencies, that is,

$$\frac{n_{1j}}{n_{2j}} \neq \frac{n_{1.}}{n_{2.}}.$$

The first case may be called the case of equal frequencies, the second the case of proportionate frequencies and the third the case of disproportionate frequencies. Since equal frequencies are proportionate, only the two classifications, proportionate and disproportionate frequencies, will be used.

Formulas for the sums of squares applicable to Case 1 are well known. These have been summarized and presented by Wishart

(1932). In Table III, these formulas and their corresponding numbers of degrees of freedom are presented, using the notation of this paper so as to extend them to proportionate frequencies other than equal.

TABLE III

Variance	Degrees of freedom	Sums of squares
2-way	1	$\Sigma\frac{(\Sigma X_{i.})^2}{n_{i.}}-\frac{(\Sigma X)^2}{n}$
s-way	$s-1$	$\Sigma\frac{(\Sigma X_{.j})^2}{n_{.j}}-\frac{(\Sigma X)^2}{n}$
Interaction	$s-1$	$\Sigma\frac{(\Sigma X_{ij})^2}{n_{ij}}-\Sigma\frac{(\Sigma X_{.j})^2}{n_{.j}}-\Sigma\frac{(\Sigma X_{i.})^2}{n_{i.}}+\frac{(\Sigma X)^2}{n}$
Within class	$n-2s$	$\Sigma[\Sigma(X_{ij}-\overline{X}_{ij})^2]$
Total	$n-1$	$\Sigma(X-\overline{X})^2$

NOTE.—The expression for the 2-way sum of squares may be written

$$\frac{n_{1.}n_{2.}}{n}(\overline{X}_{1.}-\overline{X}_{2.})^2.$$

The expression for the s-way sum of squares also may be given with the means of arrays instead of sums of arrays but it is not nearly so convenient as the form in the table. For $s=3$ the expression is

$$\frac{n_{.1}n_{.2}(\overline{X}_{.1}-\overline{X}_{.2})^2+n_{.1}n_{.3}(\overline{X}_{.1}-\overline{X}_{.3})^2+n_{.2}n_{.3}(\overline{X}_{.2}-\overline{X}_{.3})^2}{n}.$$

For the sum of squares due to interaction the expression, using means, is

$$\Sigma\frac{n_{1j}n_{2j}}{n_{.j}}(\overline{X}_{1j}-\overline{X}_{2j})^2-\frac{n_{1.}n_{2.}}{n}(\overline{X}_{1.}-\overline{X}_{2.})^2.$$

The analysis given in Table III is an extension of that in Table I, the between class sum of squares having been broken down into the three parts; between 2-way border classes, between s-way border classes, and interaction. Concerning the analysis set forth in Table I, Fisher (1932) says: "This resembles the analysis used for intraclass correlations, save that now the number of observations may be different in each array." Somewhat naturally, then, it was assumed that the frequencies need not be the same even though the individuals were classified simultaneously on two bases. That this might not be true was first brought to the writer's attention by some work by Brown (1932) on the effect of sex and generation on initial weight of some rats used in nutrition experiments in the Foods and Nutrition Laboratory at Iowa State College. She found the sum of squares due to interaction to be negative, which, of course, is not permissible, for one of the fundamental principles of the method of analysis of variance is that each partition of the sum of squares together with the appropriate number of degrees of freedom shall be the basis for an estimate of the variance of the population. A negative sum of squares would yield a negative variance and consequently an imaginary standard deviation.

This matter was taken up in a personal interview with Dr. Fisher while he was teaching at the University of Minnesota during the latter part of the summer of 1931. He suggested that a table be set up having the same border values as Table II but having the observations so adjusted that there would be no true interaction, that is, so that the interior 2-way means should differ by a constant amount. If the frequencies are proportionate this constant difference will be the same as the difference of the 2-way border means but if they are not proportionate the constant difference of the adjusted means will not be equal to the difference of the 2-way border means. This adjustment in no way affects the within class sum of squares or the total sum of squares since the adjustment is accomplished by adding (algebraically) a constant amount to each observation of a cell or sub-class. It is well known that this method of coding does not affect the sum of the squares of the deviations from the mean.

The conditions have been imposed that the differences between adjusted sub-class means in all the classes shall be equal and that the border values shall remain the same. Consequently, referring to Table II, if the adjusted means of the second row be designated x, y, and z, respectively, and the constant difference b, the adjusted means of the first row will be $(x+b)$, $(y+b)$ and $(z+b)$ respectively. On the basis of the conditions imposed above, the following equations may be written:

$$n_{11}(x+b)+n_{12}(y+b)+n_{13}(z+b)=\Sigma X_{1}. \tag{1}$$

$$n_{11}(x+b)+n_{21}x=\Sigma X_{.1} \tag{2}$$

$$n_{11}(y+b)+n_{22}y=\Sigma X_{.2} \tag{3}$$

$$n_{13}(z+b)+n_{23}z=\Sigma X_{.3} \tag{4}$$

Solving equations (2), (3) and (4) for x, y and z gives

$$x=\overline{X}_{.1}-\frac{n_{11}b}{n_{.1}}$$

$$y=\overline{X}_{.2}-\frac{n_{12}b}{n_{.2}}$$

$$z=\overline{X}_{.3}-\frac{n_{13}b}{n_{.3}}$$

Substituting these values in equation (1) gives

$$n_{11}\left(\overline{X}_{.1}+\frac{n_{21}b}{n_{.1}}\right)+n_{12}\left(\overline{X}_{.2}+\frac{n_{22}b}{n_{.2}}\right)+n_{13}\left(\overline{X}_{.3}+\frac{n_{23}b}{n_{.3}}\right)=\Sigma X_{1}.$$

The general form of this equation is

$$\Sigma\left[n_{1j}\left(\overline{X}_{\cdot j}+\frac{n_{2j}b}{n_{\cdot j}}\right)\right]=\Sigma X_{1\cdot}$$

from which the value of b is determined to be

$$b=\frac{\Sigma X_{1\cdot}-\Sigma\frac{n_{1j}\Sigma X_{\cdot j}}{n_{\cdot j}}}{\Sigma\frac{n_{1j}n_{2j}}{n_{\cdot j}}}. \tag{5}$$

This constant difference, b, is also a weighted mean of the s 2-way mean differences. It is well known that the sum of the squares of the deviations of two means from their weighted mean is equal to the product of their frequencies over the sum of their frequencies times the square of the difference between the two means, that is

$$\text{the sum of squares}=\frac{n_{1j}n_{2j}}{n_{1j}+n_{2j}}(\overline{X}_{1j}-\overline{X}_{2j})^2.$$

The above function of the frequencies, then, is taken as the weight of differences between 2-way means so that b may be calculated from the following equation

$$b=\frac{\frac{n_{11}n_{21}}{n_{\cdot 1}}(\overline{X}_{11}-\overline{X}_{21})+\frac{n_{12}n_{22}}{n_{\cdot 2}}(\overline{X}_{12}-\overline{X}_{22})+\frac{n_{13}n_{23}}{n_{\cdot 3}}(\overline{X}_{13}-\overline{X}_{23})}{\frac{n_{11}n_{21}}{n_{\cdot 1}}+\frac{n_{12}n_{22}}{n_{\cdot 2}}+\frac{n_{13}n_{23}}{n_{\cdot 3}}}. \tag{6}$$

Equations (5) and (6) are identical in value.

Table II could now be reconstructed with the adjusted means in the interior cells and the border values as they are but it is not necessary since only the constant difference between the adjusted means and border values are used in generalizing the formulas of Table III. The adjusted mean in any cell in the first row is

$$\overline{X}_{\cdot j}+\frac{n_{2j}b}{n_{\cdot j}}$$

and that in any cell in the second row is

$$\overline{X}_{\cdot j}-\frac{n_{1j}b}{n_{\cdot j}}.$$

The difference between the means in any column j, then, is b. Using the adjusted means, any interaction found by the formulas of Table III

is due to the disproportion of frequencies only, for the difference between 2-way means is constant. This interaction must be subtracted from that calculated from the original means. The expression for the sum of squares due to interaction in a $2\times s$ table with disproportionate frequencies, then, is

$$\Sigma\left[\frac{n_{1j}n_{2j}}{n_{\cdot j}}(\overline{X}_{1j}-\overline{X}_{2j})^2\right]+b^2\left(\Sigma\frac{n_{1j}n_{2j}}{n_{\cdot j}}\right). \tag{7}$$

The expression for the 2-way sum of squares is

$$\frac{n_{1\cdot}n_{2\cdot}}{n}b^2 \tag{8}$$

and that for the s-way sum of squares, using $s=3$ again, is

$$\begin{aligned}\Bigg[&n_{\cdot 1}n_{\cdot 2}\left(\overline{X}_{\cdot 1}-\overline{X}_{\cdot 2}-\frac{n_{11}n_{22}-n_{12}n_{21}}{n_{\cdot 1}n_{\cdot 2}}b\right)^2\\ &+n_{\cdot 1}n_{\cdot 3}\left(\overline{X}_{\cdot 1}-\overline{X}_{\cdot 3}-\frac{n_{11}n_{23}-n_{13}n_{21}}{n_{\cdot 1}n_{\cdot 3}}b\right)^2\\ &+n_{\cdot 2}n_{\cdot 3}\left(\overline{X}-\overline{X}-\frac{n_{12}n_{23}-n_{13}n_{22}}{n_{\cdot 2}n_{\cdot 3}}b\right)^2\Bigg]\div n.\end{aligned} \tag{9}$$

Expressions (7), (8) and (9) are general formulas for sums of squares designated in Table III as interaction, 2-way and s-way respectively, that is, they may be used for any $2\times s$ table whether the frequencies are proportionate or disproportionate providing no cell is blank. The values calculated by means of expressions (7), (8) and (9), together with the corresponding numbers of degrees of freedom in Table III, form bases for estimates of the variance of the population free of the distortion due to disproportionate frequencies, that is, estimates comparable to those based on proportionate cell frequencies. The formulas for the sums of squares of deviations as usually presented for the analysis of variance are special cases of formulas (7), (8) and (9) as may be shown readily by substituting kn_{1j} for n_{2j}, $kn_{1\cdot}$ for $n_{2\cdot}$ and $n_{1j}(k+1)$ for $n_{\cdot j}$ in formulas (5) or (6) and (7), (8) and (9). This gives the formulas for use with proportionate frequencies other than equal. By letting $k=1$ the usual forms for use with equal frequencies are obtained.

As an illustration of this generalization and as a guide to its use, the following example is given.[1] The necessary data are given in Table IV.

[1] For further illustrative examples see:
Computation and Interpretation of Analysis of Variance and Covariance, by G. W. Snedecor, Department of Mathematics, Iowa State College. Iowa State College official publication.

TABLE IV

Breed	Female		Male		Both	
	Number	Log of per cent bacon	Number	Log of per cent bacon	Number	Log of per cent bacon
Hampshire	33	66.55	89	181.04	122	247.60
Duroc Jersey	51	98.69	141	281.43	192	380.12
Tamworth	13	25.90	17	34.20	30	60.10
Yorkshire	4	7.62	9	17.58	13	25.20
Berkshire	8	14.64	4	8.20	12	22.84
Poland China	15	28.11	32	64.42	47	92.53
Chester White	35	66.90	47	90.52	82	157.42
All others	12	29.32	23	40.70	35	70.02
Total	171	331.73	362	724.09	533	1055.82

In order to calculate the total sum of squares of deviations from the mean it is necessary to have the sum of the squares of the observations. The total sum of squares is found as follows:

Number of observations	533
Sum of the observations	1055.82
Sum of squares of observations	2104.4886
$\dfrac{\text{Square of the sum of the observations}}{\text{Number}}$	2091.4744
Sum of squares of deviations	13.0142

Equation (5) is perhaps the more convenient form for finding the value of the constant difference b. Thus

$$b=\frac{331.73-\frac{33}{122}(247.59)-\frac{51}{192}(380.12)-\frac{13}{30}(60.10)-\frac{4}{13}(25.20)}{\frac{(33)(89)}{122}+\frac{(51)(141)}{192}+\frac{(13)(17)}{30}+\frac{(4)(9)}{13}}$$

$$\frac{-\frac{8}{12}(22.88)-\frac{15}{47}(92.53)-\frac{35}{82}(157.42)-\frac{12}{35}(70.02)}{\frac{(8)(4)}{12}\frac{(15)(32)}{47}\frac{(35)(47)}{82}\frac{(12)(23)}{35}}$$

$$=\frac{-6.010524}{112.4890}$$

$$=-0.053432.$$

"The Possible Rôle of Inheritance in the Quantitative Character of a Coccidian Infection of the Rat," by E. R. Becker and Phoebe R. Hall, Department of Zoölogy and Entomology, Iowa State College. To appear in early issue of *Parasitology*, Cambridge, England.

Since this is a new development concerning which nothing has been published previously, examples are not plentiful. The one in *Parasitology* was checked and accepted by two prominent English statisticians.

The sum of the squares for sex, expression (8) is

$$\frac{n_{1.}n_{2.}}{n}b^2=\frac{(171)(362)}{533}(-6.0105)^2$$
$$=(116.14)(.002855)$$
$$=0.3316.$$

The sum of squares for interaction, expression (7), is

$$\Sigma\frac{n_{1j}n_{2j}}{n_{.j}}\left[\left(\frac{\Sigma X_{1j}}{n_{1j}}-\frac{\Sigma X_{2j}}{n_{2j}}\right)^2-b^2\right]=112.49\left[\left(\frac{331.73}{171}-\frac{724.09}{362}\right)^2-.002855\right]$$
$$=112.49(.003637-.002855)$$
$$=0.0880.$$

Rather a lot of calculation is necessary for determining the sum of squares for breed using expression (9). The following modified form is more convenient

$$\Sigma\frac{\Sigma X_{ij}^2}{n_{ij}}-\Sigma\frac{n_{1j}n_{2j}}{n_{.j}}(\overline{X}_{1j}-\overline{X}_{2j})^2-b^2\left(\frac{n_{1.}n_{2.}}{n}-\Sigma\frac{n_{1j}n_{2j}}{n_{.j}}\right)-\frac{(\Sigma X)^2}{n}.$$

Thus, the sum of squares for breed is

$$\frac{(66.55)^2}{33}+\frac{(181.04)^2}{69}+\frac{(98.69)^2}{51}+\frac{(281.43)^2}{141}+\frac{(25.90)^2}{13}+\frac{(34.20)^2}{17}$$
$$+\frac{(7.62)^2}{4}+\frac{(17.58)^2}{9}+\frac{(14.04)^2}{8}+\frac{(8.20)^2}{4}+\frac{(28.11)^2}{15}+\frac{(64.42)^2}{32}$$
$$+\frac{(66.90)^2}{35}+\frac{(90.52)^2}{47}+\frac{(23.32)^2}{12}+\frac{(46.70)^2}{23}-(112.49)(.003637)$$
$$-(.002855)(116.14-112.49)-2091.4744=0.8521.$$

The sum of squares within classes is easily found by subtracting the above three portions from the total, thus

$$13.0142-(0.3316+0.0880+0.8521)=11.7425.$$

With these values the conventional analysis of variance table can be completed.

TABLE V

	D/F	Sums of squares	Mean squares
Sex	1	0.3316	0.3310
Breed	7	0.8521	0.1217
Interaction	7	0.0880	0.0126
Within	517	11.7425	0.0227
Total	533	13.0142	

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BUILDING CYCLES IN THE UNITED STATES, 1875-1932[1]

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Much attention has been directed recently to the possibility of partially stabilizing business and relieving unemployment during periods of distress, through the seasonal and cyclical control of the different individual industrial and other activities which, taken together, make up total or average general business conditions. One of these major industries is construction, of which building represents an important part and an important problem in stabilization. Among the first steps necessary in long-range planning to stabilize building activity is the examination of the nature or characteristics of building cycles. The preliminary index of the cycles of building activity from 1875 to 1932, described in this paper, was prepared for the purpose of assisting in such examinations.

It should be clearly appreciated that the index presented in this paper applies to building only—it is not an index of all construction. Highways, railways, canals, telegraph and telephone systems, power lines, sewerage systems, pipe lines, and bridges are not included. As these various forms of construction are often influenced by factors which differ from those that influence building activity, they call for separate treatment and analysis. It is believed that the cyclical control of building activity is a problem somewhat distinct from the problem of controlling other construction, all of which, in turn, may be considered as part of the entire problem of promoting stability in the production of durable goods.

Ideal data upon which to base a study of building cycles are not available. Proper measurement of monthly or yearly building activity would require figures which express directly or indirectly the amount of work done in such periods. It is obviously impossible to secure complete data on the number of units of building added during any given period. An accurate indication might be furnished, however, if data were available which would give the annual and monthly employment of men, use of equipment, and consumption of material. Since comprehensive data covering these points are not available, other figures must be used.

For the purposes of this study it was necessary to use value of building permits, as explained later. The difficulties of collecting these

[1] Revision of a paper presented at the Ninety-fourth Annual Meeting of the American Statistical Association on December 31, 1932.

data were great, as they are available for the earlier years only in occasional records.

While many questions may be raised and many criticisms may be offered, it is believed, nevertheless, that the preliminary index presented in this report is representative of the major cycles of building activity in this country since 1875. While the curve may not show short-time fluctuations with a high degree of accuracy, it is thought that the lengths and amplitudes of the major cycles are portrayed to a degree of accuracy that makes them of considerable assistance as background material in approaching the problem of stabilizing building activity.

The preliminary index of building cycles discussed in this paper represents the first step in the process of evolving a more complete index. Though it is believed to be indicative of cyclical conditions, it is not to be accepted as final and will be revised as soon as additional data can be secured, especially for the earlier part of the period covered.

This preliminary index is based upon per capita building permit values for an increasing number of cities from 1875 to 1900, and 52 cities from 1900 to 1932. The values were reduced to terms of the 1913 dollar, and a normal trend was computed. The data were then expressed in terms of percentage deviations from this trend. This index is presented graphically for the period from 1875 to 1932 in Chart I.

Building permit figures ordinarily furnish one of the best available indicators of the changes in building activity throughout the country over a long period of time. They are, however, subject to many limitations. They do not include building outside cities and sometimes they do not include government buildings within cities, nor do they indicate when, if ever, the building authorized will be constructed. The values given are only estimated, and sometimes the estimates are purposely made low if the permit fee is based on the valuation of the project, or high if the permit valuation is to be used as a sales argument. A permit places a person under no obligation to complete the building for which the permit is issued. Work may never materialize under some of the permits granted, due to difficulties such as those which often occur in a period of depression. Changes in building costs may bring the actual expenditures considerably above or below the figures designated in the permit.

When more stringent building codes or other municipal and state regulations are being considered, permits for uncertain projects are often taken out in order that the building may be constructed under the old and more lenient laws in case the project materializes. Under such conditions many permits may be issued for buildings that are never built. It should be appreciated, however, that the foregoing limita-

tions do not apply in all instances, as in many cities the valuations are carefully checked and permits are seldom secured that are not acted upon. In spite of the foregoing limitations, however, it is quite probable that few industries have a better index of activity over a long period of time than the building industry has in building permits.

The changes in building activities indicated by permits are changes in the starting of projects. They do not show the actual volume of construction going on at any particular time, as some projects may last many months or even a few years after the issuance of the permit. While this point must be kept in mind when interpreting permit data, the lag is not as important when dealing with annual data as with monthly data, since most of the permits issued in a given year cover construction completed within that year. Much of the activity connected with furnishing construction material, however, takes place before the issuance of a permit.

The preliminary index of the building cycles from 1875 to 1932 is based upon annual values of building permits from an increasing number of cities, beginning with 4 large cities in 1875 and building up to 52 cities in 1900. Starting with New York City, Chicago, Boston, and St. Louis in 1875, cities were added as follows: Minneapolis and Detroit in 1880; St. Paul in 1883; Omaha in 1885; Cleveland, Indianapolis, and Seattle in 1889; San Francisco and Milwaukee in 1890; Buffalo in 1893; Philadelphia and Los Angeles in 1894; Atlanta in 1896; Pittsburgh, Washington, Kansas City, Mo., and Denver, in 1897; New Orleans, Rochester, and Cincinnati in 1898; and Baltimore, Cambridge, Columbus, Dayton, Fall River, Grand Rapids, Hartford, Jersey City, Kansas City, Kans., Louisville, Lowell, Memphis, Nashville, Newark, New Bedford, New Haven, Oakland, Portland, Ore., Providence, Reading, Richmond, St. Joseph, Scranton, Spokane, Syracuse, Tacoma, Toledo, and Worcester in 1900.

In order to simplify the problem of trend determination and of using a varying number of cities prior to 1900, the permit values were placed on a per capita basis. The population was estimated as of July 1 of each year on the basis of a smoothed logarithmic curve drawn through the population figures for the different decennial census dates. While special adjustments for territorial annexations were made only in the more important instances, which it is believed is satisfactory for the purposes of this national study, it is considered important in analyses of local conditions to make careful adjustments for all annexations or changes in boundaries which occur between census dates.

Obviously the rate of building activity would normally be higher in a city with a rapid rate of population growth than in a city with a slow

rate of growth. In the period since 1875, the group of cities considered, taken as a whole, shows some decline in the rate of growth and, accordingly, the long-time trend of per capita building permits, in terms of the 1913 dollar, would be expected to decline during the period, unless the tendency were offset by some factor such as the rising standard of living.

Since the building permit figures used were stated in terms of value, the data were converted to their equivalents in 1913 dollars in order that the fluctuations in the volume of building activity might not be confused, owing to changes in price conditions, especially during the World War inflation period. For this purpose, a specially devised index of building costs was used for the period from 1875 to 1903 inclusive, based upon the American Appraisal index numbers of cost of industrial buildings in eastern cities. Indexes of frame building costs and of brick mill costs were used throughout the period, and to these were added indexes of frame iron-clad buildings and of steel iron-clad buildings in 1890, and indexes of reinforced concrete construction and of concrete and steel construction costs in 1900.

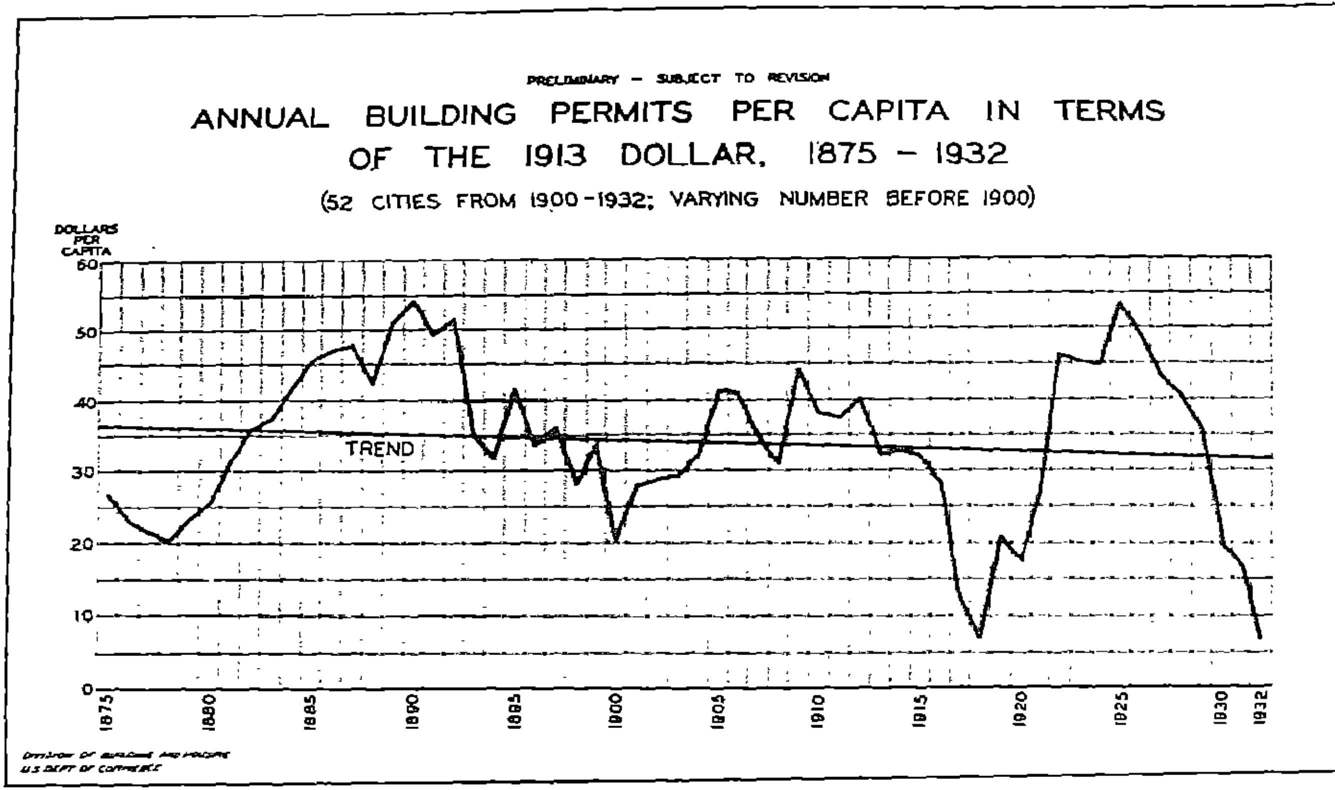
Beginning in 1904, the Engineering News-Record construction cost index was used. This index is designed to be a national index of general construction costs in the United States. It has four components, of which three are prices of materials, and one is wages. The materials are structural steel at Pittsburgh, cement at Chicago, and lumber at New York. The labor element is the average for common labor in 20 cities. These four factors are weighted according to their relative importance, which is considered to be as follows: structural steel, 2,500 pounds; cement, 6 barrels; lumber, 600 feet; and common labor, 200 man-hours. These are re-priced each month.

In using the above index of construction costs, it is recognized that its basis is limited to building material prices and labor rates and that it may not represent any of the other changes that take place in building costs, such as in contractors' overhead and profits, financing charges, architects' fees, technical improvements in machinery, economy in design, greater prefabrication of materials, and cyclical and secular variations in the efficiency of labor and management. These factors may vary considerably from time to time and the changes may not correspond to the changes in building-material prices and in total construction costs. If a synthetic index of this type does not properly reflect the changes in the efficiency of labor and management and improvements in the use of materials, its use may cause an appreciable error in the secular trend, as discussed later in this paper.

Building permits per capita, in terms of the 1913 dollar, are shown by

BUILDING PERMITS PER CAPITA IN TERMS OF THE 1913 DOLLAR, 1875 TO 1932 WITH LONG-TIME TREND

A slightly downward trend is indicated. However, an extension of the period in either direction or a long-time bias in the construction cost index used to convert the values to a 1913 basis might easily change the slope.



the curve on Chart I, and a long-time trend line (computed by the method of semi-averages) is also shown on this chart.

It will be noted that the trend decreased from approximately $36.20 per capita in 1875 to approximately $31.66 per capita in 1932, which is a decrease of about $4.54 per capita for the period, or 8 cents per year. As mentioned previously, this decline may be due to the decreasing rate of growth in the group of cities. Too much significance, however, should not be attached to the slope of this trend line as it is probable that an extension of the period either backward or forward would cause some change in slope. Furthermore, eliminating price changes by means of a synthetic cost index, based upon fixed amounts of labor and materials, might affect the trend slope. Mr. James S. Taylor, Chief of the Division of Building and Housing, believes that the cumulative upward bias in such an index becomes very considerable over a period of twenty or thirty years. He bases his opinion partly on the following data: (1) The Interstate Commerce Commission found that from 1900 to 1914 synthetic indexes of the cost of construction performed by railways showed an increase of about 14 per cent in cost, whereas it appeared that in actual practice costs in 1914 were no greater than in 1900. (2) In preparing material in 1928 for Recent Economic Changes, the Division of Building and Housing found that a preponderant number of leading building contractors, architects, and engineers agreed that the ratio of labor to material costs for building construction was about the same in 1928 as in 1913, namely, 40 per cent to 45 per cent labor and 60 per cent to 55 per cent for materials. This was in spite of the fact that wage scales in the building industry were reported as having increased by 150 per cent during the fifteen-year period, and materials only about 70 per cent, which, without technological advances, would have resulted in reversing the ratio of labor to material costs. (3) Mr. H. H. Fox, Vice President of the Turner Construction Company, has published studies showing that during the period from 1925 to 1929, output per man-hour on certain construction operations increased very substantially due to improved design, materials, mechanical equipment, tools and methods of work. While in certain actual operations, such as the laying of brick, there may have been no increase in labor productivity, it may be noted even in that case that brick is relatively a less important material than formerly, and probably less labor is required for bringing the brick and mortar materials to the brick layer's scaffold, inasmuch as the elevator and wheelbarrow have replaced the hod-carrier. If a cumulative upward bias does exist in the cost index used, it would mean that the per capita trend from 1875 instead of being slightly downward might be slightly upward.

The above qualifications apply to any interpretations that might be made of the secular trend. The objective of this particular study, however, is to show cycles, and the secular trend has been eliminated. Since any trend that has been indirectly eliminated by a steadily accumulating bias in the cost index is approximately offset by a corresponding opposite difference in the trend that is directly eliminated, the cycles in as erratic a series as the one under consideration would not be affected to any practical extent by a secular bias in the cost index.

When the building cycle curve is stated in terms of percentage deviations from the normal trend, it appears as shown in Chart II. The various characteristics of the building cycle as indicated by this preliminary curve will now be discussed.

An outstanding characteristic of the building cycle curve from 1875 to 1932 is that it shows three major cycles. In these major cycles there are many smaller cycles. The three great swings, however, since 1875 indicate quite clearly three great waves or major cycles in building activity. The smaller cyclical movements within the major cycles have their movements accelerated or retarded according to whether or not the directions of the movements in the major cycle correspond.

It will be noted that the length of a major cycle from one depression period to the next is about a business generation. The first one shown by the curve covers the twenty-two year period from 1878 to 1900 (12 years up-swing and 10 years down-swing), the second covers the twenty-year period 1900 to 1918 (9 years up-swing and 9 years down-swing), and the third, so far, has covered fourteen years from 1918 to 1932 (7 years up-swing and 7 years down-swing). Decreasing lengths of these cycles over the period are not believed to be significant due to the tremendous effect of the World War on the last cycle. The lengths of the minor cyclical movements within the major cycles ordinarily are about the same as those of the general business cycles, though they may not be coincident in point of time.

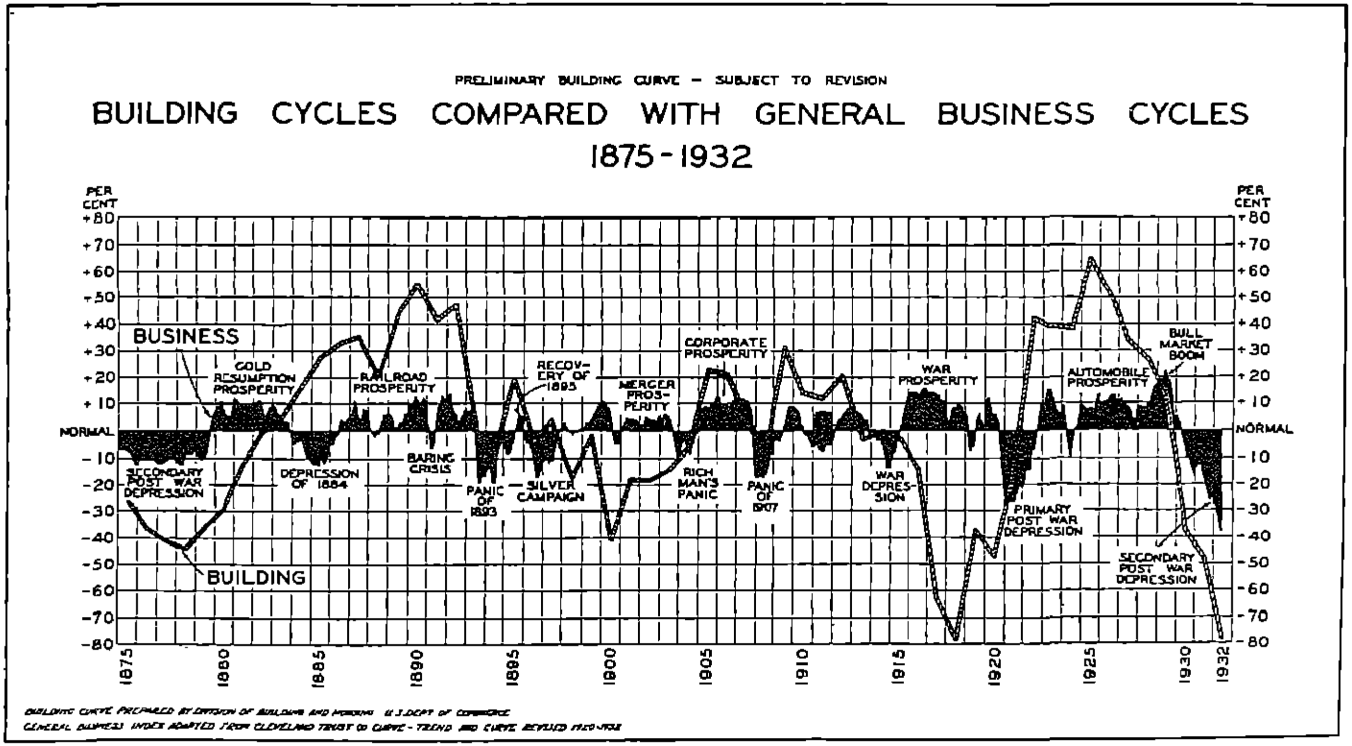
A second striking characteristic of the building cycle curve is the great amplitude of the major cyclical fluctuations. The curve moved up from 44 per cent below normal in 1878 to 55 per cent above normal in 1890, down to 41 per cent below in 1900, up to 31 per cent above in 1909, down to 78 per cent below in 1918, up to 65 per cent above in 1925, and then down to a point 78 per cent below in 1932. In the entire period shown, the highest point was in 1925, and the lowest points were in 1918 and 1932.[1] This does not indicate, however, that the am-

[1] Considered as departures from the normal trend as shown in Chart II, rather than as total dollars per capita (1913 basis) as shown in Chart I. The value per capita (in 1913 dollars) was slightly higher in 1890 than in 1925, but it was not as far above the long-time trend.

CHART II

CYCLES OF BUILDING ACTIVITY, AS INDICATED BY BUILDING PERMITS PER CAPITA FOR A GROUP OF CITIES REDUCED TO TERMS OF THE 1913 DOLLAR AND EXPRESSED AS PERCENTAGE DEVIATIONS FROM A NORMAL TREND

The group of cities begins with 4 large cities in 1875 and is built up to 52 for the period from 1900 to 1932.



plitudes of the cycles are growing greater, but is rather a result of the shortage which accumulated during the World War, and the high rate of building after the War that was necessary to make up this shortage.

It appears that while *general business cycles* usually fluctuate within a range of 20 per cent above or below normal, the major *building cycles* fluctuate from two to three times as far from normal.

Due to the wide-spread interest in attempts to help stabilize business and employment through control of building cycles, much attention has been given to the relation of building activity to general business conditions. Claims have been made that building cycles precede business cycles, and claims have also been made that building cycles follow business cycles.

Since the major building cycles appear to be several times as long as the general business cycles, there appears to be no marked correlation between them. The minor building movements within the major cycles may be more readily compared with the cycles of general business. Considering the minor building fluctuations (as shown in Chart II) it may be said that the building movement preceded the general business movement in 1878–79, 1885–86, 1889, 1895, 1899, 1904, 1909, 1911, 1912, 1921, and 1929. Building movements may be said to have followed the general business movement in 1892, and possibly at a few other points which are not distinct because of the difficulty of determining short lags when using an annual index. The most outstanding instances of opposite movements in the periods shown are from 1881 to 1885, and from 1925 to 1929. The opposite movements from 1915 to 1919 are readily explained by war-time conditions.

In conclusion, it should be pointed out that while the preliminary building cycle index presented in this report is believed to be indicative of the nation's building cycles, no interpretation should be made without due consideration of the limitations and qualifications of the data. Although the cities used in making up the index are believed to be generally representative, it is possible that they may not be representative enough for certain purposes. It is also possible that the inaccuracies of the original data may throw the curve out of line, especially in regard to the minor cycles. Furthermore, the construction cost index may not be as representative as it should be when applied to the particular group of cities used. In comparing the building cycle with the cycles of general business, the difficulty should also be kept in mind of determining an index of general business activity which accurately portrays the amplitude of the cycles in terms of percentage fluctuations from normal.

In spite of all the qualifications pointed out in this report, however, it is believed that the building cycle index presents a reasonably good picture of the fluctuations in building activity in the country for the past 58 years.

Finally, it is believed that the most noteworthy indications of the building cycle index are: (1) That major building cycles last several times as long as the usual business cycles; (2) that building cycles deviate several times as far from normal as business cycles; and (3) that while a change in business activity is quite often preceded by a corresponding minor movement in building, sometimes a business change precedes a building change, and sometimes the changes are in opposite directions.

ON PARTITION VALUES

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The term "partition values" is here used to comprise all such measures as the median, the quartiles, the deciles, the percentiles, and the like. If the definitions given by various authors for those measures be summarized, the general definition would be somewhat like this: The partition values are the magnitudes of those items in an array which divide the number of items thereof into some specified number of equal parts. Here, by *an array* is meant an arrangement of ungrouped data according to magnitude. But the common definition is inaccurate, as will be seen in the following.

Suppose an array of *continuous* data, as human body height, contains an unlimited number of items, and let a diagram of it be drawn so that the space between every two adjacent items is uniformly equal to a unit infinitely small, with the result that the array seems to be a plane as in Figure 1. Divide the base line into n equal parts and let the middle item in each part be taken out to form a sample array as in Figure 2, the spaces between the items being kept unaltered. Then the sample array in Figure 2 is strictly representative of the "gapless array" (let it be so called) in Figure 1.

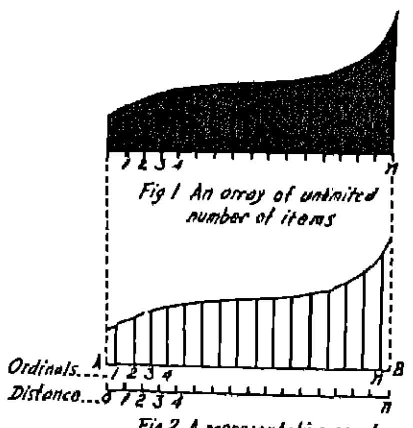

Fig 1 An array of unlimited number of items

Fig. 2. A representative sample array of n items

Now, this fundamental interpretation is suggested: To calculate the partition values in a sample array is equivalent to finding them in the

"gapless array" it represents. It will be seen that this interpretation has a general application, for to every sample array there may be assumed to be a corresponding "gapless array," the reasoning being just the reverse of the above.

In the light of this, all the difficulties ordinarily encountered in the calculation of partition values may be solved once for all. First, as the number of items is limited in a sample array, some partition values may be lacking. But in the "gapless array," in which the items are assumed to be unlimited in number, any partition item may be assumed to exist.

Secondly, the number of items in a sample array may not be divisible into equal parts; a sample of 15 items, for instance, cannot be separated into four parts, each containing an equal number of items. With the "gapless array," however, such a difficulty would not arise, since the division of its base line into some specified number of equal parts would correspondingly partition the items into the same number of equal parts.

Lastly and above all, the ends or limits of a sample array do not show themselves. A sample array is, so to speak, not enclosed at both ends. Owing to this very difficulty, erroneous formulas for calculating partition values have been given by not a few statistical authors. By the aid of the above interpretation we see now that, if the space between every two adjacent items be considered as a unit, the limits of a sample array are half a unit space beyond each of the terminating items (see Figure 2).

Having known the limits of a sample array, we can immediately get the whole length of its base line, that is, the distance between the two limits, as AB in Figure 2. Hence a new definition for partition values may be given as follows:

The partition values are the magnitudes of those items in a sample array, actually existing or interpolated, which divide the whole length of its base line into some equal parts.

It should be noted that the items bearing the partition values do not necessarily divide the *number of items* in a sample array into equal parts, as is alleged in the old common definition, although they should always do so in the "gapless array" as in Figure 1.

To calculate the partition values in an array becomes, then, so simple a matter as merely to divide its base line into some equal parts and then find the magnitudes of those items which stand at the partition points thus obtained.

Since the position of a partition item is usually expressed in terms of the ordinals of items in an array, we have to convert the units in dis-

tance into such ordinals. As will be seen from Figure 2, the numerals expressing distance are each less by ½ than the corresponding ordinals; and so the conversion just said is merely to add ½ to the former so as to get the latter. For example, in an array of n items, while Q_1 is $\frac{n}{4}$ units of distance from the lower limit, it is at the same time the $\left(\frac{n}{4}+\frac{1}{2}\right)^{\text{th}}$ item, if expressed in terms of the ordinals.

Hence the following general formula may be made:

Let an array of n items be partitioned into p equal parts, then the r^{th} partition value is the magnitude of the $\left(\frac{rn}{p}+\frac{1}{2}\right)^{\text{th}}$ item.

The 49th percentile, for example, is the magnitude of the $\left(\frac{49n}{100}+\frac{1}{2}\right)^{\text{th}}$ item in an array of n items. The median is always the $\left(\frac{n}{2}+\frac{1}{2}\right)^{\text{th}}$ or $\left(\frac{n+1}{2}\right)^{\text{th}}$ item, whatever p may be; for instance, the 50th percentile, that is, the median, has the solution of $\frac{50n}{100}+\frac{1}{2}$, which is readily reducible to $\frac{n+1}{2}$.

At this place, it is interesting to note the formulas formerly given by some authors of statistics. Except the simplest partition value, the median, which is universally calculated in the correct way, that is, as the $\left(\frac{n+1}{2}\right)^{\text{th}}$ item, the partition values are erroneously given as the $\left(\frac{r(n+1)}{p}\right)^{\text{th}}$ item, using the same notation as in the above, by such authors as King,[1] Burgess,[2] and Secrist.[3]

Indeed, there is the notable scheme given by Professor Bowley,[4] in which there are 12 separate formulas for calculating the median and the quartiles according as the number of items in an array is a multiple of 4, or such a multiple with a remainder of 1, 2, or 3. These 12 formulas, as have been tested by the writer, are indeed consistent with the single general formula given above. For instance, in case the num-

[1] W. I. King, *The Elements of Statistical Method*, 1924, p. 153.
[2] R. W. Burgess, *Introduction to the Mathematics of Statistics*, 1927, p. 137.
[3] H. Secrist, *An Introduction to Statistical Methods*, 1925, p. 357.
[4] A. L. Bowley, *Elements of Statistics*, 1920, p. 107.

ber of items in an array is $4n+1$ Professor Bowley gives the upper quartile, Q_3, as the magnitude of the $\left\{\frac{3}{4}(3n+1)+\frac{1}{4}(3n+2)\right\}^{\text{th}}$ item. According to our formula, however, it belongs to the $\left(\frac{3n'}{4}+\frac{1}{2}\right)^{\text{th}}$ item, where n' stands for the number of items, and hence is equal to $4n+1$. Then by simplification and substitution we get

$$\frac{3}{4}(3n+1)+\frac{1}{4}(3n+2)=\frac{12n+5}{4}=\frac{\frac{12(n'-1)}{4}+5}{4}$$
$$=\frac{12n'+8}{16}=\frac{3n'}{4}+\frac{1}{2}.$$

The last expression is just our formula for Q_3. In like manner all the other formulas in Professor Bowley's scheme may be shown to be reducible to the same single formula of ours. Hence we see that Bowley's scheme, though quite correct, is rather needlessly cumbrous. If a scheme of the same kind be made out for calculating the percentiles, it would contain $99\times100=9900$ separate formulas!

When data are arranged into frequency groups, the determination of partition values may be done graphically by means of an ogive or a cumulative curve. But there arises a question concerning how to partition the distance of the ordinate measure which represents the total frequency, that is, CD in Figure 3. On the one hand, many an author holds that the distance is to be divided into a specified number of equal parts, while on the other hand authors like Bowley,[1] Riegel [2] and Jones [3] make the division otherwise; they calculate the median, for instance, by taking $\frac{n+1}{2}$ units from the lower limit instead of just at the middle point of the distance in question.

Let us take the following example as an illustration and draw accordingly an ogive as in Figure 3.

Expressed class limits	Actual class limits	Frequency	Cumulative frequency
10-10	0.5-10.5	2	2
20-20	10.5-20.5	5	7
30-30	20.5-30.5	2	9
40-40	30.5-40.5	1	10

[1] Bowley, *op. cit.*, diagram facing p. 100.

[2] R. Riegel, *Elements of Business Statistics*, 1924, p. 230.

[3] D. C. Jones, *First Course in Statistics*, 1927, pp. 90-7.

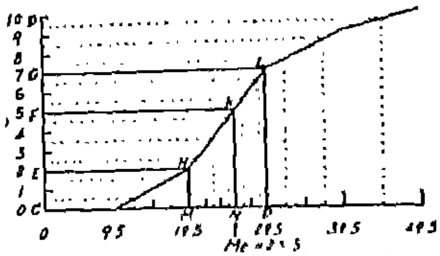

Fig 3 The analysis of an ogive

At the mid-point of each unit space along the ordinate scale let a dotted horizontal line be drawn to meet the curve and let its length, as measured by the abscissa scale, represent the magnitude of an item.[1] It will be seen that the figure thus formed is quite similar to Figure 2 showing a sample array, the only difference being that the array here is shown in a vertical position instead of a horizontal one. Thus the distance CD in the figure corresponds to the base line AB in Figure 2. According to the definition given above, therefore, CD should be divided into a specified number of equal parts and not otherwise.

The question being settled, the partition values, of course, will be given by the lengths (as measured along the abscissa scale) of horizontals drawn from the partition points to the curve. The median, for instance, is thus given in the figure as 25.5.

If the curve be smoothed,[2] the partition values then obtained will be more accurate.

The arithmetic method for determining partition values from a frequency table consists of two steps: first to take an appropriate fraction of the total frequency so as to get the location of the partition value required; and secondly to make linear interpolation in the class interval containing it. But opinions are divided among statistical authors as to the first step, though no disparity of method arises concerning the second step. Some authors take the fraction in question to be $\frac{rn}{p}$, while others as Jerome,[3] Riegel[4] and Jones[5] take it as $\frac{rn}{p}+\frac{1}{2}$, and still

[1] In this procedure there is an underlying assumption as to the distribution of items within the class intervals, viz., that a class interval be divided into as many equal sub-intervals as there are items in it and that each item be located at the mid-point of a sub-interval, which status may be seen in the figure by observing the distribution within the intervals of the feet of the dotted verticals. For the reason of upholding this assumption rather than any other of the same order, see, for instance, Burgess, *op. cit.*, p. 87.

[2] The smoothing of the curve would improve the underlying assumption concerning the distribution of items within the class intervals.

[3] H. Jerome, *Statistical Method*, 1924, p. 124.

[4] Riegel, *op. cit.*, p. 237.

[5] Jones, *op. cit.*, p. 24.

further an author[1] uses $\frac{r(n+1)}{p}$ instead. Besides all these, King gives the formula $l+\frac{c(2i-1)}{2f}$ to comprise the whole process of calculation.[2] For the sake of the statistical theory, this confusion needs to be cleared up.

Now in the writer's view, the fraction in question should be $\frac{rn}{p}$ and not in any other way. The general formula for determining a partition value in grouped data may accordingly be given as

$$l+c\frac{\frac{rn}{p}-s}{f},$$

where l = lower limit of the class containing the partition value required
c = the class interval
s = sum of items of all lower classes
f = number of items in the class.

The formula may be explained graphically by referring to Figure 3. Taking the median as an instance, we see that

$$\begin{aligned}
M \text{ (the median)} &= CN \\
&= CM+MN \\
&= l+MN \\
\text{But } MN:MP &= HK:HL \\
&= EF:EG \\
\therefore \qquad MN &= MP\frac{EF}{EG} \\
&= MP\frac{CF-CE}{EG} \\
&= c\frac{\frac{n}{2}-s}{f}. \\
\text{Hence} \qquad M &= l+c\frac{\frac{n}{2}-s}{f}.
\end{aligned}$$

In like manner, the formula may be shown to hold good for any other partition value.

[1] Secrist, *op. cit.*, p. 287.
[2] King, *op. cit.*, pp. 120 and 153.

It may be noted with interest that King's formula holds only for the median, but errs for all other partition values, as shown below.

In King's formula there is contained the letter i which, expressed in our notation, has the value $\frac{r(n+1)}{p}-s$. Substituting it in the formula we have

$$l+c\frac{2\left[\frac{r(n+1)}{p}-s\right]-1}{2f}$$

$$=l+c\frac{\left(\frac{rn+r}{p}-\frac{1}{2}\right)-s}{f}.$$

Comparing the last expression with our formula, we see that if King's formula is to be consistent with ours we must have the condition that

$$\frac{rn+r}{p}-\frac{1}{2}=\frac{rn}{p},$$

$$\text{i. e.,}\qquad \frac{r}{p}=\frac{1}{2},$$

which equation means that the partition value is at a position half-way of the whole array, that is, it should be the median. Thus it has been shown that King's formula is correct only for the median, if ours be accepted as true.

It may further be observed that King's formula might have been entirely correct, had the author known the correct rank of a partition value. As given in a previous section of the paper, the rank of a partition value is $\frac{rn}{p}+\frac{1}{2}$, and not $\frac{r(n+1)}{p}$ as alleged by Professor King. Had he taken the correct value and accordingly given i the value $\frac{rn}{p}+\frac{1}{2}-s$, his formula would have been

$$l+c\frac{2\left(\frac{rn}{p}+\frac{1}{2}-s\right)-1}{2f},$$

which, though in a complicated form, is all good and may be reduced to the very form of our formula.

All the preceding discussion refers to continuous series only. With regard to discrete series, e. g. size of families, the reasoning given above will, according to the writer's view, still hold, but with the following

modifications. First, the curve will be stair-cased; and second, the partition values will have significance only when they happen to fall at the boundaries of the steps in the curve, as shown by dotted lines in Figure 4. The shortcomings of discrete series for giving partition values are inherent and cannot but be let alone.

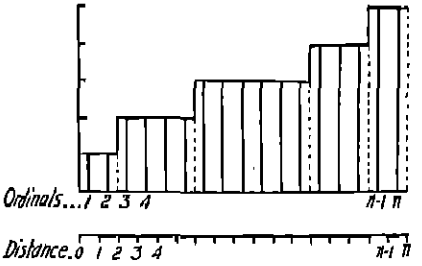

Fig. 4. An array of discrete series

THE STATISTICS OF GEOMETRICALLY CODED SCORES

By Elmer B. Royer and Herbert A. Toops, *The Ohio State University*

In the September, 1932, issue of this Journal, Dr. Halbert L. Dunn[1] described a method of multiple punching Hollerith cards whereby the capacity of the card is greatly increased. He thus improves on the ordinary method of punching in which only one position, and hence only one digit, is punched in each column. Thus, the capacity of the card is not restricted to 80 variables of one digit each, or to a corresponding lesser number of variables of two or more digits each, but one may employ as many as 80 variables, each of 4095 maximal score. Researches necessitating many more than 40 variables are comparatively frequent. It is our purpose to look into the maximum potentialities of a Hollerith card for research purposes, and to develop fully the statistics of the method.

There are twelve positions in one column of a Hollerith card, and any number of these, from none at all to twelve, may be punched. In these twelve positions, no holes at all, meaning a score of zero, may be punched; and there is only one such possible score. Twelve holes may be punched singly for twelve different scores; or in sets of 2 holes each in 66 ways, for 66 other scores, and so on. Finally, at the end of the series, all twelve holes may be punched, standing for the score 4095. Accordingly, if none of the variables has a maximum score larger than 4095, some 80 variables of this, or of lesser range, may be punched into the Hollerith card as shown by Dr. Dunn. The detail thus secured is seldom essential.

If, then, in addition to multiple punching, we permit the grouping of raw scores, we still further increase the capacity of the card and at the same time lessen the labor required in counter-printer tabulation. If we allot six positions to a variable instead of twelve, we can get two variables to a column, or 160 variables in all. Each such variable may have 2^6, or 64, categories or classes. If each variable is allowed four positions, three variables can be punched in each column, or 240 variables in all. Each variable could then have 2^4, or 16, categories or classes. If each variable is allowed three positions, 320 variables, of 8 categories or classes each, may be punched in one card. Since the grouping error is likely to be appreciable if the number of groups is not larger than 8, we choose the preceding alternative and so conclude

[1] Halbert L. Dunn, "Adaptation of New Geometrical Code to Multiple Punching in Mechanical Tabulation," this Journal, Vol. 27, No. 179, 1932, pp. 279–286.

that the maximum capacity of the Hollerith card, using multiple punching, is 240 variables of 16 categories each. Our formulas and illustrations below are for four positions, although they can easily be extended to any number.

Suppose that we wish to punch three variables into a column of the Hollerith card. The twelve positions of the column of a Hollerith card, in descending order, will be represented by the letters a to l. The topmost four, a, b, c, d, will be allotted to variable X; the middlemost four, e, f, g, h to variable Y; and the bottommost four, i, j, k, l, to variable Z. Any score, between the limits 0 and 15 in these three variables, may be schematized in the following three formulas:

$$\begin{aligned} X &= 1a+2b+4c+8d \\ Y &= 1e+2f+4g+8h \\ Z &= 1i+2j+4k+8l \end{aligned} \tag{1}$$

in which, if the hole corresponding to a small-case letter is punched the letter has the value 1; otherwise, zero. Thus 11 in variable X is punched according to the following formula;

$$\begin{array}{ccccc} X & a & b & c & d \\ 11 = & 1(1) + & 2(1) + & 4(0) + & 8(1), \end{array}$$

that is, positions a, b and d are punched while c is left unpunched.

As a second example, 10 in variable Y corresponds to the punching of the formula,

$$\begin{array}{ccccc} Y & e & f & g & h \\ 10 = & 1(0) + & 2(1) + & 4(0) + & 8(1), \end{array}$$

that is, in positions f and h of the same column, while e and g are left unpunched.

The merits of formulas (1) are that any desired moments or product moments, in terms of the coded scores, may be determined by a simple manipulation of the appropriate summated expressions; for example,

$$\begin{aligned} \Sigma X &= \Sigma(1a+2b+4c+8d) \\ &= 1\Sigma a+2\Sigma b+4\Sigma c+8\Sigma d \end{aligned} \tag{2}$$

where

Σa is the number of all the cards *punched* in the a-position of the column in question;

Σb the number of cards punched in the b-position, etc. This is the formula for Dr. Dunn's method of finding the summation of his multiple punched score, necessary for finding means.

$$
\begin{aligned}
\text{And, } \Sigma XY &= \Sigma(1a+2b+4c+8d)(1e+2f+4g+8h) \\
&= 1\Sigma ae + 2\Sigma af + 4\Sigma ag + 8\Sigma ah \\
&\quad + 2\Sigma be + 4\Sigma bf + 8\Sigma bg + 16\Sigma bh \\
&\quad + 4\Sigma ce + 8\Sigma cf + 16\Sigma cg + 32\Sigma ch \\
&\quad + 8\Sigma de + 16\Sigma df + 32\Sigma dg + 64\Sigma dh
\end{aligned}
\tag{3}
$$

where, by our above definition, it follows that Σab is the number of cards punched in *both* the a- and b-positions of a *given* card. If only one of these two positions is punched, the term becomes zero. If we multiply $XY = 11 \times 10$, as above punched, we obtain, by formula (3),

$$
\begin{array}{lcccc}
X\ \ Y & ae & af & ag & ah \\
11(10) = & 1(0)+ & 2(1)+ & 4(0)+ & 8(1) \\
 & be & bf & bg & bh \\
 & +2(0)+ & 4(1)+ & 8(0)+ & 16(1) \\
 & ce & cf & cg & ch \\
 & +4(0)+ & 8(0)+ & 16(0)+ & 32(0) \\
 & de & df & dg & dh \\
 & +8(0)+ & 16(1)+ & 32(0)+ & 64(1) = 110
\end{array}
$$

If then, for a number of cards, we can determine how many are jointly punched in the ae positions, the af positions, etc., we may substitute these numbers for the 1's and 0's which occur in the parentheses of the above symbolic multiplication, thus, after doing the sixteen indicated multiplications, finding ΣXY. Finding Σab on the printer-counter simply means: (1) sorting out from the pack all those cards punched in the a-position; then, (2) counting how many of these a-punched cards are punched in the b-position—in short, tabulating on the column these a-punched cards yields us at one operation all of the quantities aa, ab, ac, . . . , al, twelve in all, of the frequencies of the topmost row of Table II in which we are proceeding to find nine intercorrelations, as denoted by the coördinates of the table.

We shall work out the summations necessary for solving all the intercorrelations of three variables, X, Y and Z, for persons A to T, whose original scores occur in the first four columns of Table I.

The letters appearing in the section at the right of the scores represent the positions to be punched in the several cards to represent these scores. Thus, person A, who has X, Y, and Z scores respectively of 11, 8 and 12 would have six positions, a, b, d, h, k, l, punched in the column of Card A allotted to these three variables. The coding of the three scores of a given individual may be verified by referring to the fundamental equations (1). The squares, cross-products, and summations of these scores appear in the other columns of Table I as a means of verifying the later computations.

TABLE I
COMPUTATIONS BY PENCIL-AND-PAPER METHODS

Individual	Grouped scores			Holes to be punched in column of corresponding card			Computations for verification *					
	X	Y	Z	X	Y	Z	X^2	Y^2	Z^2	XY	XZ	YZ
A............	11	8	12	*ab d*	*h*	*kl*	121	64	144	88	132	96
B............	8	10	6	*d*	*f h*	*jk*	64	100	36	80	48	60
C............	4	9	0	*c*	*e h*		16	81	0	36	0	0
D............	14	6	13	*bcd*	*fg*	*i kl*	196	36	169	84	182	78
E............	0	7	5		*efg*	*i k*	0	49	25	0	0	35
F............	7	4	9	*abc*	*g*	*i l*	49	16	81	28	63	36
G............	9	3	11	*a d*	*ef*	*ij l*	81	9	121	27	99	33
H............	15	7	11	*abcd*	*efg*	*ij l*	225	49	121	105	165	77
I............	1	2	4	*a*	*f*	*k*	1	4	16	2	4	8
J............	6	14	3	*bc*	*fgh*	*ij*	36	196	9	84	18	42
K............	12	9	11	*cd*	*e h*	*ij l*	144	81	121	108	132	99
L............	8	15	9	*d*	*efgh*	*i l*	64	225	81	120	72	135
M............	13	5	15	*a cd*	*e g*	*ijkl*	169	25	225	65	195	75
N............	10	13	7	*b d*	*e gh*	*ijk*	100	169	49	130	70	91
O............	9	8	10	*a d*	*h*	*j l*	81	64	100	72	90	80
P............	6	1	2	*bc*	*e*	*j*	36	1	4	6	12	2
Q............	2	11	1	*b*	*ef h*	*i*	4	121	1	22	2	11
R............	3	7	9	*ab*	*efg*	*i l*	9	49	81	21	27	63
S............	5	0	8	*a c*		*l*	25	0	64	0	40	0
T............	7	12	6	*abc*	*gh*	*jk*	49	144	36	84	42	72
Total........	150	151	152				1,470	1,483	1,484	1,162	1,393	1,093

* Not computed in actual practice.

The cards are first punched as indicated in Columns 5–16 of Table I. As the first step, we simply tabulate all the cards on the column, counting the number of holes punched in all positions. This yields the row of frequencies (Table II) labeled "All" at the left end. These are

TABLE II
TABLE PRINTED BY THE COUNTER-PRINTER (ONE COUNTER)

		Variable X				Variable Y				Variable Z				
	Sort	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*	*l*	Total
	All....................	10	10	10	10	11	10	10	10	12	10	8	11	20 = N
X	*a*....................	10	5	5	5	4	4	5	3	5	5	4	8	10
	b....................	5	10	6	4	5	5	7	5	7	5	4	5	10
	c....................	5	6	10	4	5	3	6	4	6	6	3	6	10
	d....................	5	4	4	10	6	5	5	6	7	7	5	8	10
Y	*e*....................	4	5	5	6	11	6	6	5	9	6	3	6	11
	f....................	4	5	3	5	6	10	6	4	8	4	4	5	10
	g....................	5	7	6	5	6	6	10	4	9	5	5	6	10
	h....................	3	5	4	6	5	4	4	10	5	6	4	4	10
Z	*i*....................	5	7	6	7	9	8	9	5	12	6	4	8	12
	j....................	5	5	6	7	6	4	5	6	6	10	4	5	10
	k....................	4	4	3	5	3	4	5	4	4	4	8	3	8
	l....................	8	5	6	8	6	5	6	4	8	5	3	11	11

employed both in getting the means, checking the correctness of the sortings, and as a second check on the major-diagonal entries of Table II on which there is no absolutely dependable independent count, and to find N.

Next, by split-sorting all the cards punched in the *a*-position—namely, cards *A*, *F*, *G*, *H*, *I*, *M*, *O*, *R*, *S* and *T* are sorted out. These 10 cards are tabulated and counted on the column, producing the first row of frequencies. Then, we split-sort on position *b*, obtaining the 10 cards, *A*, *D*, *F*, *H*, *J*, *N*, *P*, *Q*, *R*, *T*, punched in this position whereupon the counting is repeated.

The process is so continued for all twelve positions. While split-sorting on position *a*, all cards are being counted for row "All." Both kinds of operations proceed concurrently throughout. After completing the tabulations, the entire table should be checked for symmetry about the major diagonal. The numbers in the major diagonal should check with the corresponding entries of the Total column, and with the corresponding entries of the row "All." If all of these checks hold, we are certain that the sorting and the counting have been properly done, and are ready to do the computations, as shown in Tables III and IV.

TABLE III
COMPUTATIONS OF SUMS OF SCORES (ΣX, ΣY, ΣZ)

Numerical coefficient	Variable X		Variable Y		Variable Z	
	Freq.	Ext.	Freq.	Ext.	Freq.	Ext.
1	10	10	11	11	12	12
2	10	20	10	20	10	20
4	10	40	10	40	8	32
8	10	80	10	80	11	88
Total	$\Sigma X = 150$		$\Sigma Y = 151$		$\Sigma Z = 152$	

TABLE IV
EXAMPLES OF COMPUTATIONS OF SUMMATIONS OF CROSS-PRODUCTS

	Numerical coefficient	Variable X		Variable Y	
		Freq.	Ext.	Freq.	Ext.
X	1	10	10	4	4
	2	10	20	9	18
	4	20	80	15	60
	8	22	176	19	152
	16	18	288	16	256
	32	8	256	9	288
	64	10	640	6	384
	Total	$\Sigma X^2 = 1{,}470$		$\Sigma XY = 1{,}162$	

The computations of Table III are based on the "All" row of Table II, where all the cards were run through and counted. This again is Dr. Dunn's method.

The computations of Table IV are based on the twelve rows of Table

II, occurring below the row, "All." The frequencies in each 4-fold square within this table—representing a correlation plot—are added by diagonals and the totals entered in Table IV. We show the computations for ΣX^2 and ΣXY only. The 5 and 5 (Σab and Σba) are added to give 10 before multiplying by their common numerical coefficient 2. This can be understood by referring back to equation (3). In practice the extensions will not be written, but will be cumulated in the lower window of the calculator, and their total read directly when all of the multiplications have been done. There are only seven such extensions to be made. These totals check for symmetry. Since there is no check for the totals in the principal diagonal, these should be done a second time. The resulting table (Table V) checks, if correctly done, for symmetry about the major diagonal.

TABLE V
THE FINAL TABLE OF PRODUCT MOMENTS FOR INTERCORRELATION COMPUTATIONS

$1470 = \Sigma X^2$	$1102 = \Sigma XY$	$1303 = \Sigma XZ$
$1102 = \Sigma YX$	$1483 = \Sigma Y^2$	$1003 = \Sigma YZ$
$1303 = \Sigma ZX$	$1003 = \Sigma ZY$	$1481 = \Sigma Z^2$

The reduction of these to an intercorrelation table may be done most efficiently in a schematic intercorrelation-solving table.[1]

Dr. Dunn showed how to find ΣX, ΣY, and ΣZ. We have shown how to find ΣX^2, ΣY^2, ΣZ^2, ΣXY, ΣXZ, and ΣYZ.

For second degree curve fitting, we need ΣX^3, ΣX^4; these and other higher moments and product moments may be readily found from cards which have been multiple punched, but the procedure is somewhat more involved and will not be illustrated here. The required formula for ΣXYZ is:

$$\Sigma XYZ = \Sigma(1a+2b+4c+8d)(1e+2f+4g+8h)(1i+2j+4k+8l). \quad (4)$$

The sorts required maximally involve finding and counting all cards punched concurrently in three positions, e.g. in a, e, and i positions, thus requiring two sortings—on a- and e-positions—previous to counting on the counter-printer the frequency of the i-holes.

In view of the fact that the scores of any variable readily can be transmuted to small-sized scores which in turn can be coded for multiple punching, and proofed thereafter by eye, by printing the numbers 1, 2, 4 and 8 on the four successive positions of a card allotted to a variable, it follows that no tables, such as used by Dr. Dunn, are needed for the punching of these smaller sized coded scores, or for the interpretation

[1] Herbert A. Toops, "Computing Intercorrelations of Tests on the Adding Machine," *Journal of Applied Psychology*, Vol. 6, No. 2, 1922, pp. 177 ff.

of the punched scores. All correlation plots become 4-fold by 4-fold tables as shown. On a counter-printer with three rolls, one sorting of the cards gives us compartmental entries of nine separate correlation coefficients. After every four sortings, nine correlations are complete. Twelve sorts, and subsequent countings, of the cards must be made to complete all twenty-seven correlations. But the sorting and counting proceed concurrently and at an optimal speed of 24,000 cards per hour. Thus, with more counters, the potential speed in finding intercorrelations is many times that of tabulating machine methods and not only with checked accuracy, but also with a minimum of subsequent calculation.

NOTES

INDUSTRIAL CLASSES IN THE UNITED STATES IN 1930

BY TILLMAN M. SOGGE, *University of Minnesota*

Professor Alvin H. Hansen in two articles published earlier in this JOURNAL classified the gainful workers from 1870 to 1920 into industrial classes. His first article "Industrial Class Alignments in the United States" appeared in the issue of December, 1920, and the second article entitled "Industrial Classes in the United States in 1920" in the issue of December, 1922. This brief paper brings these earlier articles up to date.

Only two minor changes in the earlier occupational classifications have been made for 1930. Mechanical engineers have been transferred from the proprietors and officials to the professional group; and hunters, trappers and guides from the proprietors and officials to the unclassified group.

Tables I and II indicate the number and percentage of gainful workers falling in each of the occupational groups for each ten year period from 1870 to 1930.

TABLE I
OCCUPATIONAL GROUPS

	1870	1880	1890	1900	1910	1920	1930
Farm laborers	2,885,000	3,323,876	3,001,001	4,410,877	6,143,998	4,178,637	4,302,764
Farmers	3,000,220	4,282,074	5,370,181	5,770,739	6,220,101	6,463,709	6,070,231
Proprietors and officials	581,378	807,040	1,347,329	1,811,715	2,870,023	3,108,418	4,270,850
Professional	414,708	666,338	1,114,507	1,505,080	2,074,702	2,760,100	3,845,550
Lower salaried	300,413	520,473	965,852	1,320,928	2,303,620	3,085,306	7,116,814
Servants	975,734	1,075,655	1,451,701	1,453,677	1,572,225	1,270,946	1,000,133
Industrial wage earners	*3,328,351*	*5,280,820*	*7,360,442*	*10,263,560*	*14,559,079*	*17,048,072*	*18,512,940*
Unclassified	1,010,114	1,420,705	2,118,408	2,467,013	2,317,538	2,138,071	2,612,920
Total	12,505,923	17,392,099	22,735,661	29,073,233	38,167,336	41,614,218	48,829,920

TABLE II
OCCUPATIONAL GROUPS (PER CENT)

	1870	1880	1890	1900	1910	1920	1930
Farm laborers	23.1	19.1	13.2	15.2	16.1	10.0	9.0
Farmers	24.0	21.6	23.6	19.8	16.3	15.5	12.4
Proprietors and officials	4.6	4.6	5.9	6.2	7.5	7.6	8.7
Professional	3.3	3.8	4.9	5.4	5.4	6.6	7.9
Lower salaried	2.5	3.0	4.3	4.6	6.3	9.0	14.6
Servants	7.8	6.2	6.4	5.0	4.1	3.1	4.1
Industrial wage earners	26.6	30.4	32.4	35.3	38.2	42.4	37.9
Unclassified	8.1	8.2	9.3	8.5	6.0	5.1	5.4

Analysis of these tables reveals a number of interesting developments. Farm laborers show an absolute increase but a relative decrease in importance. The absolute increase of about 200,000 is perhaps in large part due to the fact that the census of 1920 was taken in January, whereas the census of 1930 was taken in April. The latter being a much busier agricultural season it is likely that a large number of the farm laborers of 1930 would have been listed in some other labor group if the census had been taken in January. Farmers continued to decline in relative importance, but at an accelerated rate decreasing 20 per cent in relative importance from 1920 to 1930 as compared to about 5 per cent from 1910 to 1920.

The most significant change has occurred in the industrial wage earning group, which for the first time has failed to increase in relative importance. Even though an absolute increase of over 800,000 can be noted for the last decade, the relative importance of this group has declined about 11 per cent.

The professional group and the proprietors and officials have continued to increase in importance. However, it is in the lower salaried and the servant groups that the greatest increases have taken place. The lower salaried group has been increasing in relative importance with each passing decade since 1870. Since 1900 the ratio of this group to the total gainful workers has increased about 217 per cent. The following table shows the percentage increase for each period in the ratio of the lower salaried group to the total gainful workers.

1870 to 1880	20.0	per	cent	increase
1880 " 1890	43.3	"	"	"
1890 " 1900	6.9	"	"	"
1900 " 1910	36.9	"	"	"
1910 " 1920	52.4	"	"	"
1920 " 1930	52.1	"	"	"

In the second of the previously mentioned articles, Professor Hansen pointed out that servants had been steadily declining in relative importance from 1870 to 1920, and explained that a part of this was due to a transfer of housework from homes to factories. Here it is significant to note that since 1920 the percentage increase in the ratio of servants to total gainful workers is about 32 per cent.

The "urban upper and middle" classes including the proprietors and officials, professional and lower salaried groups have continued to increase in importance. The proportion of gainful workers in this group increased from 23.8 per cent of the total in 1920 to 31.2 per cent in 1930. On the other hand the "urban workers," including the industrial wage earners and servants, had increased from 42.3 per cent

of the total in 1910 to 45.5 per cent in 1920, but declined in relative importance to 42.0 per cent of the total gainful workers in 1930. The "rural group," including farmers and farm laborers, continued to wane in importance decreasing from 25.5 per cent in 1920 to 21.4 per cent in 1930.

Farm laborers, farmers, industrial wage earners, and servants are largely "manual workers" whereas the professional, the lower salaried, and proprietors and officials may perhaps be broadly regarded as "brain workers." Since 1870 the ratio of "brain workers" to gainful workers has steadily increased, and the ratio of "manual workers" to gainful workers has decreased. All three groups included as "brain workers" have increased in relative importance since 1870, but the greatest increase was made by the lower salaried group due to the constantly increasing importance of trade in our industrial system. The industrial wage earners is the only group from the "manual workers" that has increased relatively to gainful workers since 1870. Since 1920, however, due largely to technological development, the ratio of industrial wage earners to total gainful workers also has been decreasing, adding another factor making for a decrease in the proportion of "manual workers." The substantial increase in the proportion of servants since 1920 has been insufficient to offset the proportionate decrease in industrial wage earners, farmers and farm laborers, so that since 1920 the ratio of "manual workers" to gainful workers again decreased. The proportion of gainful workers in each of these two groups in 1870 and for each ten year interval since 1900 is as follows:

	Manual workers	Brain workers
1870	81.5	10.4
1900	75.3	16.2
1910	74.7	10.2
1920	71.0	23.8
1930	63.4	31.2

If we may consider farmers, farm laborers, and industrial wage earners chiefly as "material goods workers," and the professional, lower salaried, and servant groups as "service rendering workers," further light can be shed upon the problem mentioned in the preceding paragraph. Since 1870 there has been a definite and steady proportionate increase in service rendering workers, and a decrease in the proportion of material goods workers. This shift has been especially accentuated in the past decade by the decrease in the proportion of gainful workers listed as industrial wage earners and the increase in the proportion of lower salaried workers. The proportion of gainful workers found in

these two groups in 1870 and for each ten year period since 1900 is as follows:

	Material goods workers	Service rendering workers
1870	73.7	13.0
1900	70.3	15.0
1910	70.0	15.8
1920	67.9	19.3
1930	60.9	26.6

The United States Bureau of the Census groups the gainful workers into ten major occupational divisions. I have re-classified these ten divisions into two groups as follows: the first, "production and transportation activities" and the second, "trade and service activities." The results substantiate what has already been indicated above. The "production and transportation activities" includes the gainful workers enumerated under agriculture; forestry and fishing; extraction of minerals; manufacturing and mechanical industries; and transportation and communication. In the group entitled "trade and service activities" are included the gainful workers enumerated under trade; public service; professional service; domestic and personal service; and clerical occupations. The proportion of the total gainful workers in each group for 1910, 1920, and 1930 is listed below.

PRODUCTION AND TRANSPORTATION ACTIVITIES

	1910	1920	1930
Agriculture, forestry * and fishing	33.2	26.2	21.9
Extraction of minerals	2.5	2.6	2.0
Manufacturing and mechanical industries	27.8	30.8	28.9
Transportation and communication	6.9	7.4	7.9
Total	70.4	67.0	60.7

* The two groups, agriculture, and forestry and fishing, have been combined in this table into one group because in the 1910 census these occupations were included in one group called agriculture, forestry and animal husbandry.

TRADE AND SERVICE ACTIVITIES

	1910	1920	1930
Trade	9.5	10.2	12.5
Public service	1.2	1.8	1.8
Professional service	4.4	5.2	6.7
Domestic and personal service	9.9	8.1	10.1
Clerical occupations	4.6	7.5	8.2
Total	29.6	32.8	39.3

Production and transportation activities have decreased in importance since 1910 due, chiefly, to the decline in the proportion of gainful workers in agriculture, and since 1920 to a decreased proportion in manufacturing and mechanical industries. On the other hand the increased proportion of gainful workers in trade and service activities has been caused chiefly by the increase in trade, professional service and in clerical occupations, and strengthened by an increase in domestic and personal service occupations since 1920.

In Table III the percentage change in relative importance of the occupational groups (determined from the percentages listed in Table II) has been converted into index numbers using 1870 as the base or 100.

TABLE III
TRENDS IN RELATIVE IMPORTANCE

	1870	1880	1890	1900	1910	1920	1930
Farm laborers	100	83	57	66	70	43	30
Farmers	100	103	98	83	68	65	52
Proprietors and officials	100	100	128	135	103	165	169
Professional	100	115	148	164	164	200	230
Lower salaried	100	120	172	184	252	384	584
Servants	100	70	82	64	53	40	53
Industrial wage earners	100	114	122	133	144	150	142
Unclassified	100	101	115	105	74	63	67

This table presents no additional material but may help to clarify for the reader the degree of change which has affected each group. It indicates clearly that farmers, farm laborers and servants have decreased greatly in importance since 1870. Proprietors and officials have increased steadily during this time, and industrial wage earners increased until 1920, but then declined. The greatest increases, however, are found in the professional group which has more than doubled in importance, and the lower salaried group which has increased nearly six fold in relative importance since 1870.

ALGEBRAIC DERIVATION OF THE NORMAL EQUATIONS INVOLVED IN MULTIPLE AND PARTIAL CORRELATION

By C. Horace Hamilton, *North Carolina Agricultural Experiment Station*

Differential calculus is usually employed by statisticians in the derivation of the normal equations involved in multiple and partial correlation.[1] The simple algebraic derivation which is presented in this note will be found useful in teaching students who do not have a knowledge of calculus. It is entirely probable that this derivation has appeared elsewhere and certain that others have used it.[2] However, a canvass of representative mathematicians and textbooks of statistics indicates lack of familiarity with the approach. The primary object of this note, therefore, is merely to call attention to the simplicity and usefulness of the algebraic method.

Consider first the normal equations involved in linear multiple and partial correlation as given by Kelley.[3]

$$
\begin{array}{l}
r_{01}-\beta_{01}-\beta_{02}r_{12}-\ \ldots\ -\beta_{0n}r_{1n}=0\\
r_{02}-\beta_{01}r_{12}-\beta_{02}-\ \ldots\ \ \beta_{0n}r_{2n}=0\\
\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
r_{0n}-\beta_{01}r_{1n}-\beta_{02}r_{2n}-\ \ldots\ -\beta_{0n}=0
\end{array}
$$

In the derivation of the above equations we shall use Kelley's notation, one essential characteristic of which is the use of standard measures where $z_n=\dfrac{X_n-M_n}{\sigma_n}$. The first step in the derivation is to write the conventional linear estimating equation

$$z_0=\beta_{01}z_1+\beta_{02}z_2+\ldots+\beta_{0n}z_n. \tag{I}$$

The significant assumption underlying the above equation is that β_{01}, β_{02}, and β_{0n} are such weights as will give the best possible estimate of the dependent variable, z_0. From this assumption it necessarily

[1] See Truman L. Kelley, *Statistical Method*, p. 282; Frederick C. Mills, *Statistical Methods*, p. 563; Mordecai Ezekiel, *Methods of Correlation Analysis*, p. 378. However, compare G. Udney Yule, *An Introduction to the Theory of Statistics*, Sixth Edition, Chapter XII, particularly pp. 231–238.

[2] Professor E. B. Wilson of Harvard University has used this method of derivation for some years in his classes, a fact which I discovered only after submitting this paper to him. Professor Wilson understands also that Bowley uses this method in London. Professor Wilson also points out: that the method described herein parallels closely that of Yule; after a derivation by calculus is once made, an algebraic demonstration (using the theorems developed by the calculus) may be easily made; and that in dealing with linear equations, it is never necessary to use the calculus in the first place because one can always discuss the problem of a minimum by reducing the quadratic expression to a sum of squares.

[3] Kelley, *op. cit.*, p. 290.

follows that the errors of estimate or residuals $z_0-\beta_{01}z_1-\beta_{02}z_2-\ .\ .\ .\ -\beta_{0n}z_n$ are uncorrelated with the independent variables,[1] so that

$$\Sigma(z_1)\ (z_0-\beta_{01}z_1-\beta_{02}z_2-\ .\ .\ .\ -\beta_{0n}z_n)=0. \tag{2}$$

Completing the algebraic multiplication and writing in the summation sign we have the first normal equation.

$$\Sigma z_0z_1-\beta_{01}\Sigma z_1^2-\beta_{02}\Sigma z_1z_2-\ .\ .\ .\ -\beta_{0n}\Sigma z_1z_n=0. \tag{3}$$

Dividing by N (the number of cases) we have the equation in the form given by Kelley

$$r_{01}-\beta_{01}-\beta_{02}r_{12}-\ .\ .\ .\ -\beta_{0n}r_{1n}=0 \tag{4}$$

since, in using standard measures, $\frac{\Sigma z_1^2}{N}=1$, and $\frac{\Sigma z_0z_n}{N}=r_{0n}$. The remaining normal equations are obtained in a similar manner.

The distinctive feature of this short derivation of the normal equations is that it utilizes directly the obvious fact that, by the very nature of correlation and estimation, the residuals are not correlated with (cannot be estimated from) the independent variables. Yule uses the "least squares" criterion in his algebraic derivation of the normal equations. Professor Harold Hotelling of Columbia points out in a letter the fact that the criterion of least squares is, as can be shown geometrically, equivalent to zero correlation.

[1] Kelley, *op. cit.*, p. 284.

A PRESIDENTIAL LETTER

To Members of the American Statistical Association:

Through the courtesy of the Editor, I am permitted to address you in this manner upon several related questions of importance to the Association.

From widely scattered sources, both in this country and abroad, come accounts of political attacks upon important statistical services. The political bigotry which has disrupted the statistical offices of some European governments, differs more in its intensity than in kind from the obscurantism which has expressed itself in dismissals from the statistical offices of a number of American states and cities.

At Washington, this attitude has not appeared; but the speed with which the new administration is seeking to reduce expenditures and effect reorganization carries with it dangers. The commendable energy with which bold steps are taken under high pressure may result in essential technical services being scrapped or crippled. Even if discontinued statistical work were subsequently resumed, the damage meanwhile might be considerable.

The necessity of reducing expenditures has everywhere been recognized, in private business even more than in governmental and quasi-public services. Statistical work and statisticians cannot be immune to this necessity. There are differences, however, in the manner of its legitimate application to us. In pruning their expenses, business enterprises will weigh carefully the comparative values of their various departments. Statistical departments must face on their merits the competition for existence which such scrutiny produces. In the case of governmental cost reductions, public interest should be the criterion which determines priorities; but there is danger that well-organized pressure groups, representing special interests in government concessions or contracts, patronage awarded to political henchmen, or unessential activities, will in many cases protect these at the expense of scientific and research services. Those very attitudes and mental habits which characterize the personnel of a scientific staff are not favorable to concerted action for the protection of their work.

It seems to me that our Association is not obligated to indifference in such situations. It is a scientific body, interested in the perfection and extended use of statistical methods and techniques in economic and social affairs. It is also a professional organization, concerned with the vocational well-being of its members. No apology is needed for its attention to the latter as well as the former. In most cases the two interests will coincide. The same events which relieve statisticians of employment are likely to eliminate or reduce the scientific services they have performed.

Resistance by members of the Association to cuts in governmental costs is far from my thought. Quite the contrary. But aggressive concern with the allocations of cuts among the services subject to them is another matter. Opportunities for good citizenship as well as scientific responsibilities are both involved. Governmental costs are often disproportionately high when compared with the services which the citizen receives. They would in many cases be much higher than they are except for the work of government research bureaus, government

statisticians and accountants. If reorganization and simplification of government are to lead simultaneously to economy and to improvements in services, as they might, more and not less research and statistics in government will be required.

Vigilance upon a broad front by the Association, its committees, and its members, seems demanded. Your officers and committees are coöperating at a number of points in the formulation of proposals affecting the statistical work of the federal government. We are not correspondingly prepared to assume a coöperative rôle in the statistical work of the states and their subdivisions. A larger interest by members in the latter seems important.

In a number of communities, "*Citizens' Councils for Constructive Economy*" will be formed for cities or states, composed of local representatives from a number of national civic, social and scientific organizations. It seems to me that representatives from our Association might properly, and profitably to their profession, participate in these Councils, or in other local movements having objectives similarly constructive.

The chapters of the Association, more than at any time in the past, should find their own *raison d'être* in upholding statistical standards within their communities. In this they would follow the precedent of their parent organization. The "long and beneficent contact" of the American Statistical Association with the federal census, to quote a history of the latter, began with the returns of the 1840 enumeration. That contact has been continuous, and has extended to other statistical activities of the federal government. The Association's legitimate concern with federal statistics is everywhere recognized. I need only cite the work of the present Committee on Labor Statistics, and the recent request of the Secretary of Labor for a special committee to advise her on the reorganization of the statistical work in her department.

Some of the greatest deficiencies in American statistics, and some of the greatest opportunities for constructive statistical development, are to be found in the governments of states, cities, and other local jurisdictions. With respect to these the Association, as a national body, is ill prepared to render service. Should not the chapters assert an interest here, akin to that of the parent body in the statistical organization at Washington? How else are the local improvements, so badly needed, to be accomplished? In an American city containing a strong local chapter of the Association, it is said to be the practice for each incoming municipal administration to devise new record forms which involve new contracts with printers. The political motives and the wastes of public funds which this practice involves do not, perhaps, concern the members of this chapter as such; but the periodic destruction of public records, and the deliberate forfeiture of comparability among them from administration to administration are statistical offenses which might legitimately provoke its vigorous efforts for reform. An active standing committee on municipal record forms, in this instance, might win notable advances for science as well as good government.

With so much to be done and with statistical standards so often endangered, would not the chapters be vitalized if they were to assume the responsibility for defending and developing the statistical work of state and local government? I

think so. The long established methods of committee activity developed within the parent association offer sufficient precedents as to procedure, with the added advantage that committee members would not have to come together from distant points.

If responsibilities of this kind are recognized as belonging to the chapters, which would thus divide the field of responsibility, so to speak, with the parent organization, the argument for further chapter organization seems to me to become unanswerable. The membership of the Association is sufficiently concentrated to permit easily of a doubling of the present number of chapters. Are there not members in communities lacking chapters who will take the initiative in starting them? The first steps taken need be neither formal nor difficult. The most recent applicant for a charter, the Philadelphia Chapter, met informally as a "statistical group" during a self-imposed probationary period of about two years, in order to gain cohesion through a natural process of growth, without artificiality.

A final query: Would it not be desirable that some of the papers presented at the next annual meeting should give indications of the types of data required for social controls which news dispatches from Washington are now discussing? If government is to become an agency for the more effective organization and "control" of social economy, as present tendencies seem to indicate, its research and statistical services will increase correspondingly in importance. Anything like "social planning" (whatever the term may mean concretely) will require much more data and research than at present. This conclusion is not evident to many critics, who are prone to revile the statistician and economist for failure to chart in advance the course of depression; but many of these critics, I think, are open to demonstration.

Again, does not the same train of thought suggest the special importance at this time of the effective coördination of the statistical services of the government, both national and local, among themselves and with the services of non-governmental agencies? Should this subject be stressed in the annual program?

I close with a request for suggestions, both general and specific, upon the questions I have raised. I likewise solicit information upon what is occurring to the statistical services of state and local governments throughout the country. Such information, for obvious reasons, is difficult to obtain from other sources. Its assemblage may provide a basis for further action by the Association.

Stuart A. Rice

University of Chicago

AWARDS OF THE SOCIAL SCIENCE RESEARCH COUNCIL, 1933-34

The Social Science Research Council announces the award of forty-two Grants-in-Aid of research, fifteen new fellowship appointments, two fellowship re-appointments for periods of one year, and two fellowship extensions for less than one year. The Grants-in-Aid totalled $10,290; the fellowships, $49,000.

As in previous years, the Grants-in-Aid were awarded to assist mature scholars in the completion of research projects already well under way.

The fellowships were designed to afford opportunity for research training, preferably interdisciplinary in nature, rather than to assist in the carrying out of research projects as such. As in previous years, they were open to citizens of the United States and of Canada not over thirty-five years of age who possessed the Ph.D. or its equivalent in research training and experience.

The closing date for the receipt of applications for Grants-in-Aid for the academic year 1934–35 will be February 1, 1934; for Fellowship applications, December 1, 1933. In order to facilitate the filing of applications on the proper blanks before the closing dates, it is requested that persons interested communicate with the Secretary for Fellowships and Grants-in-Aid, 230 Park Avenue, New York City, as early in the fall of 1933 as possible. The first letter of inquiry should include a brief statement of the candidate's proposed plan of work and of his academic and professional record.

A list of the appointments for the academic year 1933–34 follows:

Grants-in-Aid:

Nels Anderson, Seth Low Junior College; Howard F. Barker, U. S. Tariff Commission; Viola F. Barnes, Mount Holyoke College; William C. Binkley, Vanderbilt University; Lynn M. Case, The Rice Institute; John M. Cooper, Catholic University of America; E. Merton Coulter, University of Georgia; Earl E. Cummins, Union College; Albert R. Ellingwood, Northwestern University; Luther H. Evans, Princeton University; Martin L. Faust, University of Missouri; Nathan P. Feinsinger, University of Wisconsin; Frederic H. Guild, University of Kansas; J. P. Guilford, University of Nebraska; Leonard C. Helderman, Washington and Lee University; Melville J. Herskovits, Northwestern University; Edgar A. J. Johnson, Cornell University; Vernon Jones, Clark University; Eugene M. Kayden, University of the South; Susan M. Kingsbury, Bryn Mawr College; A. R. M. Lower, Wesley College; Arthur F. Lucas, Clark University; Henry S. Lucas, University of Washington; Alpheus T. Mason, Princeton University; Robert A. McKennan, Dartmouth College; Frank Monaghan, New York University; Richard B. Morris, College of the City of New York; Ernest R. Mowrer, Northwestern University; Curtis P. Nettels, University of Wisconsin; Chester W. New, McMaster University; Ronald L. Olson, University of California; Louise Overacker, Wellesley College; Frank W. Pitman, Pomona College; Max Sasuly, American University; Francis B. Simkins, State Teachers College, Farmville, Virginia; Keith Sward, Pennsylvania College for Women; Charles C. Tansill, American University; Paul S. Taylor, University of California; Amry Vandenbosch, University of Kentucky; Arthur P. Watts, University of Pennsylvania; Mary W. Williams, Goucher College; Raymond R. Willoughby, Associate Editor, *Psychological Abstracts.*

Fellowships

Nathaniel Cantor, University of Buffalo (three months extension of 1932–33 fellowship); W. Ellison Chalmers, University of Wisconsin; W. Rex Crawford, University of Pennsylvania; Calvert L. Dedrick, University of Wisconsin;

George H. Dession, Yale University; Harold F. Dorn, University of Wisconsin; Howard S. Ellis, University of Michigan; Paul W. Gates, Bucknell University; Edward P. Hutchinson, Massachusetts Institute of Technology; Lester E. Klimm, University of Pennsylvania; Albert Lepawsky, University of Chicago; Charles P. Loomis, Harvard University; Arthur W. Marget, University of Minnesota; Quinn McNemar, Stanford University; Elio D. Monachesi, formerly University of Minnesota (one year extension of 1932–33 fellowship); Stanley S. Newman, formerly Yale Sterling Fellow (one year extension of 1932–33 fellowship); Morris Ploscowe, formerly National Commission on Law Observance and Enforcement (five months extension of 1931–32 fellowship); Lawrence Preuss, University of Michigan; Sylvia L. Thrupp, London School of Economics.

THE ADEQUACY OF VARIOUS METHODS OF RELIEVING THE UNEMPLOYED

A dinner meeting of the American Statistical Association was held on Friday evening, January 27th, 1933, at the Hotel Woodstock, 127 West 43rd Street, New York City. Fifty-eight persons were present. The general topic for discussion was, "The Adequacy of Various Methods of Relieving the Unemployed."

Professor Frederick E. Croxton of Columbia University presided. He began by calling attention to the enormous expense of unemployment relief in the United States at the present time, showing that New York City was spending, currently, at the rate of $7,000,000 per month for this purpose. Relief costs for the United States as a whole are not accurately known but a rough estimate has been made that the total relief bill in 1932 was around $500,000,000. Furthermore, as time passes, the demand for relief grows more and more insistent, the reason being that private savings are becoming exhausted because of the long periods of unemployment.

Statistics for certain areas of the city of Buffalo indicate that last fall about 60 per cent of those unemployed had been out of work a year or longer. Obviously, few such persons have remaining private resources adequate for their support.

The first speaker on the program was Dr. Corrington Gill of the Federal Employment Stabilization Board. He spoke on the subject, "Public Works." Dr. Gill presented a number of excellent charts showing the changes in the amounts spent for construction work during the last decade. One interesting fact brought out by his analysis was that, between 1929 and 1932, there was a very sharp volume decline in both private construction work and that undertaken by the states and municipalities. By contrast, the Federal government spent twice as much for construction in 1932 as it did in 1929. However, since the total amount spent by the Federal government constituted but a small proportion of total construction expenditures, the increase in Federal expenditures did not go far in the way of offsetting the decrease in other construction.

There were two reasons for the sharp decline between 1929 and 1932 in state and municipal expenditures for public works. The first reason was that a large part of the money normally going to public works was diverted to more direct relief of the unemployed. A second and very important reason was that, in 1932,

state and municipal credit broke down to such an extent that it was extremely difficult to sell the bonds of these governmental organizations.

Another of Dr. Gill's charts showed that 41 per cent of all money paid for construction work normally goes to pay the wages and salaries of persons directly engaged therein. About half of the total expended on construction goes for materials. The states leading in the production of such materials are Pennsylvania, Ohio, New York, Alabama, and Illinois. Pennsylvania is the chief producer of cement and structural steel. Alabama turns out more cast iron pipe than any other state.

Other graphs presented by Dr. Gill showed that fluctuations are, roughly, three times as great in those industries producing durable goods, such as steel, automobiles, lumber, and the like, as they are in the industries turning out non-durable goods, such as clothing and food. It follows that, if we could stabilize the demand for durable goods, such as those used for the construction industries, we would thereby go far toward stabilizing the demand for labor.

The last of the charts presented showed that, although Federal expenditures for public works have always moved in cyclical waves, their volume has, ever since 1800, tended to increase along a trend which plots approximately as a straight line on a ratio chart, the typical percentage of increase being about 5 per cent per annum.

The second speaker of the evening was Earl E. Muntz. Professor of Economics at New York University. He dealt with the topic, "Unemployment Insurance and Unemployment Reserves." He began by stating that Belgium and France are typical of nations having voluntary unemployment insurance systems originally organized by trade unions. In Belgium, approximately one-fifth of the workers take out such insurance. Their contributions are paid into a fund, both supervised and subsidized by the Government, the subsidy being proportional to the contributions made by the employees. The employee is supposed to receive two-thirds of his regular wage whenever he is unemployed. In the present unusually severe depression, this system has proved inadequate since it has provided for regular benefits continuing only 50 days. Furthermore, when the depression arrived, three-quarters of the workers were not covered because they had never taken out insurance. As a result, the Belgian Parliament began, in 1930, to make direct contributions through what is called, "A National Crisis Fund." Such contributions represent little more than public poor relief.

England is typical of the European nations which have compulsory unemployment insurance. Under the original plan adopted before the World War, employers, employees, and the Government were all compelled to contribute to an insurance fund. This original plan was not adequate to cover any severe period of unemployment, for it provided for benefits for only fifteen weeks of unemployment during the year, and no worker could receive more than one week of benefit payments for each five weeks of contributions to the fund.

At the close of the World War, the system was extended to cover practically the whole of the working-class population, and this, together with provision for "extended benefits" for those whose right to regular benefits was exhausted, resulted in the insolvency of the fund when emergencies, such as the depression of 1921–22

occurred. Hence the fund was forced to borrow from the Government to meet its obligations. Such borrowings finally amounted to some $500,000,000. In 1930 the pretense of borrowing was abandoned and the extended or transitional benefits were made a direct charge upon the Exchequer. The British system has thus virtually become "outdoor poor relief," as far as a large proportion of the beneficiaries are concerned.

Recently, much attention has been given to the question of establishing unemployment reserve funds. Wisconsin is the first state to make legal provision for such funds. Under the Wisconsin law, employers are given until June 1st, 1933, to arrange satisfactory voluntary methods of insuring their employees against unemployment. If, at the date mentioned, such plans do not cover satisfactorily as many as 175,000 employees, each employer of ten or more workers will be compelled by law to establish a separate unemployment reserve for the benefit of his own employees. However, governmental units and employers engaged in agriculture are exempt from the provisions of the law. If the act becomes compulsory, each employer will be required to pay into an individual unemployment reserve fund administered by the State Industrial Commission, 2 per cent of the wages, bonuses, and salaries of all employees, with the exception of certain contractional agreements to be reported to the commission, and all salaries and wages in excess of $300 per month. This 2 per cent reserve must be accumulated until a fund of $55 per employee is on hand, after which the rate falls to 1 per cent until the fund totals $75 per employee. When an employee loses his job through no fault of his own, he receives from the reserve funds of those employing him during the year, benefits at the rate of $10 per week or 50 per cent of his average weekly wage, whichever is lower, except that when 50 per cent of the wage is less than $5, a minimum benefit of $5 is payable. Benefits, however, extend for ten weeks only.

It is obvious that, in a period of severe unemployment such as we have experienced during the last two years, benefits for ten weeks annually would only begin to take care of the difficulty. To provide for long periods of unemployment, reserves much greater than $75 per employee would be necessary, and, to accumulate such reserves, contributions of more than 2 per cent of the payroll would probably be necessary. It is doubtful, however, that it is politically feasible to build up enormous reserves, for, in prosperous times, everyone would feel that large accumulations were entirely unnecessary.

While both unemployment insurance and unemployment reserve systems may be of material assistance to the more diligent and competent sections of the working class, they do little toward solving the problem of caring for the subnormal, inefficient, and aged groups of workers, the classes which make up a large proportion of the chronically unemployed. These latter groups must be taken care of by other devices.

To make unemployment insurance or reserve funds function properly, it is essential to have in action an adequate system of public employment exchanges and facilities for re-educating workers who have been dropped out of occupations which have become obsolete.

Since, in general, unemployment insurance gives inadequate protection, it

must necessarily be supplemented by public charity whenever depressions become unduly severe. Sound procedure, however, requires that charity be carefully differentiated from unemployment insurance or reserve provisions. The chief merit of the reserve plan is that it furnishes a strong incentive to employers to stabilize employment. This incentive might have considerable effect in such industries as could be made amenable to stabilization. It is difficult, however, to see that it could have much influence on the volume of employment in extractive industries like coal mining, or in the manufacture of iron and steel. The reserve plan in this connection should be most effective in stabilizing employment in states where diversified industry prevails, where the manufacturing plants are not too highly specialized, and are small or medium in size and can quickly be adapted to other uses or forms of production.

The last regular speaker of the evening was Mr. Richard A. Lester of Princeton University. He spoke on the topic, "Government Directed Self-Support." He expressed the view that, during the present depression, our efforts to relieve unemployment have been tending to pass through four successive phases. In the first phase, stress was laid upon increased construction of public works. In most places, this device has, however, broken down because it has proved too expensive for the communities to bear.

There has, therefore, been a widespread movement toward paying labor money wages for "made work." In the second stage, strong emphasis has been laid upon the necessity of seeing that publicly-employed workers are engaged solely in lines of work believed not to compete with private enterprise—this particular type of work being stressed because of the erroneous belief that, if workers should produce other goods, these products would take away the demand previously existing for similar goods. The truth is that the unemployed worker who has no income of his own gives rise to no additional demand for goods, since the money which he spends is taken from others and would be spent by them for commodities, if they were not compelled to contribute to the relief of the unemployed. It is true, however, that if most of the unemployed were set to work producing one or two products, the supply of such articles would become unduly large and those engaged in these industries would be injured.

Relieving the unemployed through "made work" has proved extremely burdensome to the public. A considerable proportion of the money received by the workers has necessarily gone to pay rent and similar charges. Since, in many sections of the country, it is becoming more and more difficult to secure charitable contributions or even to collect taxes, the drift is now toward the old-fashioned method of direct charity. When food orders are handed to the unemployed, the landlords are left to look after the housing, and the city escapes this burden. Obviously, however, this system tends to pauperize the recipients of direct relief.

Since all of the three methods thus far discussed have proved so unsatisfactory, a more scientific and effective way of handling the problem has been sought. In some sections, an attempt has been made to send the unemployed back to the land. At present, however, we are suffering from a plethora of agricultural produce, agriculture being one industry in which there has been no tendency for production to fall off since 1929. In manufacturing, on the other hand,

production is off nearly one-half. Clearly, here is a field in which more people need to be employed.

It is obvious that our economic machine is stalled. Until it can be started running again, the only logical procedure is to set the unemployed to producing the things which they need for themselves. It is foolish to transplant them to occupations with which they are not familiar. Any satisfactory plan must, therefore, cover a great variety of industries. Furthermore, it must be so arranged as to insure consumption of articles produced by the unemployed. To accomplish this end requires a proper technique. The system will not work unless the income of the producers is made to correspond roughly with the value of the products turned out.

Professor Frank D. Graham of Princeton University proposes that the Government should contract with present entrepreneurs, in a great variety of industries, to set the unemployed to work. The workers should be paid in scrip and, in any period, the total value of the scrip should bear such a proportion to the money value of the goods produced as to assure a full consumption of the product. This plan has not been put into operation anywhere, but it is being seriously considered in California, Washington, and other parts of the West.

As a variant to this plan, Professor Graham has proposed that mail order houses such as Sears, Roebuck and Company, or Montgomery Ward, increase considerably their orders for goods of the type greatly in demand among the working class. The mail order establishment would, however, inform the manufacturers or jobbers from whom the goods were purchased that payment for these goods would necessarily be made in due bills redeemable at any of the stores of the mail order organization. The manufacturer receiving such due bills would promptly distribute them among his employees, paying to each employee only a fraction of his wages in this medium. In many cases, it might be feasible for the firm receiving the due bills to pass them on to producers from whom they had purchased raw materials. In any case, the due bills would soon be flowing back to the mail order concern in payment for goods, and the volume of employment in the country would be greatly increased.

While this system has not been put into actual operation, there has been springing up almost spontaneously, especially in the western part of the United States, a large system of barter-exchanges. These exchanges are issuing scrip in payment for labor and goods. In Los Angeles, at present, 40,000 families are being cared for in this manner, the total expense to the public having been reduced to $0.20 per family per month. This figure may be contrasted with the $10 or $12 per family per month formerly expended for relief. In Utah and vicinity, a barter-exchange system is producing goods to the extent of $5,000 to $10,000 per day at the present time. One of the obstacles to the smooth functioning of these exchanges appears to be that, as soon as competent executives develop, they are likely to be drafted into private industry. This fact seems to indicate the desirability of having a permanent skeleton organization of experts, paid by the state. Were such a skeleton organization provided, the economic effectiveness of such measures could be increased, and there would be less danger of the system falling into the hands of extremists.

The discussion was begun by Dr. Paul P. Gourrich. He raised the question as to how huge unemployment reserves could be successfully invested. In reply to Dr. Muntz' suggestion that the reserves be invested in a well-diversified list of Federal, state, and municipal bonds, Dr. Gourrich inquired as to whether such investment would not raise bond prices materially during prosperous times when the reserves were being accumulated, and cause a collapse of bond prices when the depression appeared and the reserves were marketed to secure funds to cover unemployment payments.

Dr. Gourrich endorsed heartily the main thesis presented by Mr. Lester—namely that the problem of eliminating unemployment becomes one of organizing all classes of unemployed for the purpose of producing and bartering among themselves the things they themselves consume. He suggested that this end might be accomplished if the Reconstruction Finance Corporation and public and private charitable organizations united to establish a coöperative chain of Producing and Bartering Guilds, using Guilds' due bills as a medium of exchange. The organization of such Producers' Guilds would be greatly simplified by arrangements with existing factories to supervise labor and production.

This plan would not only make it possible to re-employ the unemployed people through self-helping coöperatives, but would help and give permanency to the incomes of those who are now employed. Surprising increases in spending might reasonably be expected, as soon as people begin to see the "spiral" move upward instead of down. There would be a release of purchasing power of those having income, part of which they now contribute directly or indirectly (through taxation) for relief purposes.

Plans of relief, which do not provide that the unemployed produce the things which they consume, are likely to bring in their wake complications and financial disorders perhaps as serious as those which the schemes are intended to remedy.

Dr. Woodlief Thomas quoted Professor Sumner Schlicter as advocating the deposit of unemployment reserves in the Federal Reserve Banks. Were this proposal adopted, money would be withdrawn from industry during boom times and paid out during periods of depression. Dr. Thomas further suggested that the best form of unemployment relief was employment, which could be obtained through business recovery, and stated that the first two speakers did not even claim that their proposals would bring about business recovery. He felt that, while the plan presented by the last speaker would be helpful in providing local relief, it could not be attempted on a nation-wide basis without further upsetting the existing system of production, distribution, and finance.

WILLFORD I. KING, *Secretary*

NEW DEVELOPMENTS IN INSURANCE REVEALED BY STATISTICS

A dinner meeting of the American Statistical Association was held on Tuesday evening, February 28, 1933, at the Hotel Woodstock, 127 West 43rd Street, New York City. Forty-eight persons were present.

Professor Ralph H. Blanchard of Columbia University presided. The general

topic for consideration was "New Developments in Insurance Revealed by Statistics."

The first speaker of the evening was Henry Moir, President of the United States Life Insurance Company, who dealt with the general subject "Life Insurance." Mr. Moir began by pointing out the fact that policy loans have tended to expand rapidly with the passage of time. The ratio of policy loans to reserve has, in fact, increased from about 5 per cent a half century ago, to 16 per cent in 1928, and to approximately 20 per cent at the present time. This increase in demand for cash has been met by the insurance companies.

The custom is to carry the policy loans on the books of the company as assets. This method of bookkeeping is open to criticism, for, obviously, these loans cannot be used to pay the debts of the insurance companies. In reality, these loans represent offsets against liabilities. The policyholders are not borrowing from the insurance companies, but from their beneficiaries.

One type of asset which has recently been troubling the insurance companies greatly is the farm mortgage. During the depression, the farmers have been finding it more and more difficult to pay interest on their mortgage indebtedness. In the year 1932, a typical group of companies paid out more money in trying to keep the farmers on their farms than they received in interest. Despite the best endeavors of the insurance companies to avoid making foreclosures, they are now accumulating a very considerable amount of farm real estate. This is not the first time that such has been the case. In 1880, real estate holdings constituted about 12 per cent of the assets of insurance companies. Later, they declined to about 2 per cent, but the present depression has brought the proportion up to 8 per cent.

Recently, many well-intentioned persons have contended that, with the decline in the value of property, the loss should be distributed approximately in like proportions, among the holders of the farm equities. For example, if the value of the farm has declined by one-half, they urge that the mortgage be diminished, likewise, by one-half.

This line of reasoning is faulty in that it overlooks the true origin of most farm mortgages. During the last boom in agricultural land, the value of farm mortgages in the United States trebled. This increase was caused, not by poverty, but by prosperity. Everyone observed that farm products were rising rapidly in price. Under the circumstances, it is not surprising that thousands of people bought farms for speculation, giving mortgages for the larger part of the purchase price. When farm values fell, the speculators naturally found themselves in difficulties.

Before concluding that farm mortgages ought to be scaled down, it is well to ask oneself: What would have occurred if the farms had risen further in value? Would the speculators have felt it incumbent upon themselves to turn over part of their profits to the mortgage holders? If not, is it fair to ask that, when the price level falls, the mortgage holders should share in the losses, although they would not have been allowed to participate in the gains if the price level rose?

The second speaker of the evening was Mr. William Leslie, Associate General Manager of the National Bureau of Casualty and Insurance Underwriters. The

topic of his address was "Casualty Lines." Mr. Leslie began by pointing out that casualty insurance covers a great variety of risks. The relative importance of different types of casualty insurance is indicated by the following figures representing percentages of the total of all casualty insurance: automobile insurance, 36.6; workman's compensation, 24.6. Accident and health insurance comes next in order of importance.

Insurance rates must be set before the accidents occur which call for payments of indemnity. This means that the probable rates of accidents must be calculated long in advance of the time at which they occur. To secure reasonable accuracy in such advance calculations is by no means easy. Difficulty arises in this connection because of the fact that the accident rate refuses to remain constant.

This fact is illustrated by the case of Ford automobiles. When the Model "A" cars appeared, the accident rate immediately increased 21 per cent. This sharp increase was due to the fact that the Model "A" car was heavier and traveled faster than did the old Model "T" car. The present eight cylinder Ford car has nearly four times the horsepower of the Model "T" car. The weight is also much greater in the case of the new car. While the insurance companies expected that the accident rate would increase, they did not find it easy to secure material upon which to base their estimates, as to how much the rate would expand. The result was that many companies wrote automobile insurance on an unprofitable basis.

Mr. Leslie also described the relative change which has taken place in the case of insurance against bank burglary as compared with the insurance against bank robberies. Formerly, losses from burglary were heavy and from robbery negligible. Then came the advent of fast automobiles and the acquisition of machine guns by bank robbers. The losses from bank robbery have become much more important than losses from burglary.

Unfortunately, the figures upon which rates are to be computed are never available until after the events have happened; hence, it is necessary to introduce some element of judgment in the making of rates for lines of insurance which are influenced to a marked degree by changes in economic or social conditions.

The third regular speaker of the evening was Mr. Albert Z. Skelding who spoke on "Workmen's Compensation." He also emphasized the fact brought out by the preceding speaker, that, in general, considerable time elapses between the time when experience is incurred and the time when such experience is made available to a statistical organization for rate making purposes. The natural result is that when the detailed statistics do become available the "new developments revealed by statistics" are no longer recent or new. In compensation insurance the liability of the insurance carrier in the event of injury to a workman is fixed by law. The premium paid to the insurance company for a compensation policy is based on a charge per $100 of payroll. When wages decline the premium income of the insurance company declines proportionally. However, due to the various provisions of the Compensation Acts, the amount payable as compensation does not decline in general as rapidly as the premium income. In addition, medical payments made by the carrier, not being based upon wages, do not decline at all with a drop in premium income.

Furthermore, when part time work is the rule, it is possible in some states for an injured workman to receive more income from compensation insurance than he would receive if he were working. Under such circumstances the natural tendency may be to magnify small injuries and to prolong compensation payments as long as possible.

In times of economic depression, physicians, finding it difficult to collect from their other patients, may be influenced to offset this factor by giving unnecessary treatments to injured workmen.

Occupational disease is becoming a problem of serious importance. The tendency is for the cost of occupational disease claims to increase, due to ever increasing liberality in the interpretation of what constitutes an occupational disease. Typhoid fever contracted in a manufacturing establishment by the drinking of impure water has been held to be an occupational disease. Pneumonia claimed to have been contracted by an exposure to a draft has also been held to be an occupational disease. This concept of occupational disease is quite different from that which led to the original enactment of the laws providing compensation for the victims of occupational diseases.

The last regular speaker on the program was Mr. Lawrence E. Falls of the American Insurance Company. He discussed "Fire and Marine Insurance," and, in so doing, pointed out that insurance companies in this field have recently suffered heavy losses, not primarily because the volume of business has declined greatly, but mainly because of a terrific shrinkage in the values of the securities in which the assets of the companies have been invested. Fortunately, only a few small companies have as yet failed. Not a single member of the National Board of Fire Underwriters has thus far failed to meet an obligation to policyholders.

The volume of premiums collected has diminished materially. Losses arising from this source have been partially offset through savings accruing because of improved construction of buildings. It must, however, be admitted that fires are more likely to occur in times of depression than in times of prosperity. Most of the expenses of the insurance companies have been reduced radically, but the tax burden has increased rather than diminished.

One source of losses to the insurance companies has been that numerous agencies have not succeeded in collecting the money due on policies which they have renewed. In some cases, these agencies are now unable to meet their obligations to the companies. However, the great majority of agencies are believed to be still solvent.

The discussion was opened by Mr. C. G. Smith, the Manager of the New York State Insurance Fund. He raised the question as to whether the custom of basing workmen's compensation upon the payroll is logical. He pointed out that the insurance companies suffer from the fact that supervising officials are commonly reluctant to allow increases in insurance rates but are nearly always ready to grant reductions.

Several points were brought out by persons participating in the general discussion from the floor. For example, the fact was noted that the tendency to compute rates on a scientific basis is of relatively recent origin.

At present there is a great difference in the ratio of expenses to premiums in different insurance companies. The highest grade of life insurance companies keep their expenses under 20 per cent, while the worst company on record has expenses of 60 per cent of all premiums received. In general, there is a tendency for the expense percentage to be higher in the case of small than in the case of large companies.

The question was raised as to whether the custom of making the agent's commission consist of a given fraction of the initial premium is sound. This arrangement makes the agent interested only in securing the signature of the prospect. He does not care how soon the policy is allowed to lapse. Policies written on this basis show an unnecessarily high portion of lapses.

WILLFORD I. KING, *Secretary*

ARE WE MENACED BY MACHINES?

A meeting of the American Statistical Association was held on Tuesday evening, March 7, 1933, at the Auditorium of the New School for Social Research, 66 West 12th Street, New York City. Seventy-eight persons were present.

Willford I. King, Secretary of the Association presided. The general topic for discussion was, "Are We Menaced by Machines?" Leon Henderson, of the Russell Sage Foundation, made a brief introduction in which he raised the question as to whether the real menace of "The Machine Age" does not lie in its influence upon the volume of business, upon the world price level, and upon the distribution of wealth, rather than in any effect which it may have in bringing about unemployment.

Carl Snyder, of the Federal Reserve Bank of New York, who was to have been the second speaker of the evening was ill, and hence unable to appear. His place was therefore taken by LeBaron Foster who presented a number of charts prepared under Mr. Snyder's direction and discussed their meaning.

The graphs on these charts showed clearly that, in the United States, production per capita has had a remarkably steady upward trend during the last one hundred and forty years, the proportionate rate of growth having shown very little change during that period. There is nothing in the available figures to indicate that, during recent years, machines have brought about any increase in the steepness of this upward trend. What is really observable is that, since 1929, actual production has decreased sharply. There is no reason to suppose that this decline represents anything more than a temporary phenomenon. While machines have increased production and caused it to rise faster than population, there is no evidence whatever to indicate that this increase in productivity has tended to lessen the demand for labor. As a matter of fact, the proportion of the population engaged in gainful work has been steadily rising. In 1820, estimated data reveal that only 25.8 per cent were gainfully occupied. In 1870, the first year in which official census data became available, the percentage had risen to 32.4 per cent, and, in 1930 it stood at 39.8. The indications are that, in 1929, there was as close an approach to full employment as has ever been known in the history of the United States. Under these circumstances it is hard to find

any ground for assuming that machines have a tendency to reduce total employment.

The belief that they do have such tendencies is nothing new. Adam Smith refers to it in his *Wealth of Nations*, Karl Marx discusses it in *Das Kapital*. Of course, machines do constantly displace workers, but they also provide other opportunities for employment.

It is true that, since 1920, the proportion of the population employed in manufacturing has declined. On the other hand, the fraction of gainfully occupied workers engaged in agriculture has been falling off rapidly since 1870. This does not mean, however, that there has been a net decline in employment. Trade, transportation, clerical, professional, and other service-rendering pursuits have been increasing at a rapid rate. What has happened is that workers have shifted from agriculture, and in the past decade, from manufacturing industries, into other fields in which the economic demand is stronger.

Mr. Foster closed by presenting charts showing that, in the manufacturing industry, the ratio of wage payments to the value added by manufacture has shown a pronounced downward tendency during recent decades. In this connection, the point was raised by Meredith Givens that the wage payments referred to did not include salaries of clerical and professional employees in the manufacturing industry, and that, if these items were included, the decline might not exist.

The next speaker was Bassett Jones of Meyer, Strong and Jones, Inc. He began by calling attention to the fact that it is extremely difficult, if not impossible, to forecast, long in advance, future production in the various industrial fields. He showed, for example, that such able statisticians as Simon Kuznets and Carl Snyder do not agree on the nature of the mathematical curve representing the known change in pig-iron production. Mr. Jones showed that mathematical curves representing such early stages of development in almost any type of production, if produced into the future, are likely to run into fantastic figures. He presented the thesis that every form of production, and, indeed, production as a whole, must reach a period of maximum growth after which the growth necessarily declines. The typical curve representing the production of a non-reproducible article such as copper shows an increasing rate of production during the earlier periods. Eventually, the *growth* of production reaches a maximum and then gradually falls to zero as production itself approaches a maximum, and thereafter declines. On the other hand, the production of freely reproducible commodities does not necessarily go into decline, but is likely, in time, to approach a horizontal trend, at which time its growth is zero.

Mr. Jones presented statistics indicating that the growth of the aggregate debt of the industries of the United States has been much greater than the growth in the physical output of these industries, the growth of the latter having reached a maximum between 1905 and 1915. He ascribed this situation to the fact that lenders have overestimated the possible rates of growth in the various industries. In many instances, bonds have been issued, running for periods longer than the life of the physical plant purchased with the money secured through the sale of the bonds. This procedure is obviously unsound.

When debt charges increase more rapidly than production, financial readjustment must necessarily occur. The present depression is a natural outcome of this situation and is unique in industrial history in that it occurred subsequent to the date of maximum growth of production.

Mr. Jones, in closing, asserted that the proper relationship between debt and production is a matter of relative growths, not of total quantities. When production ceases to grow, the possibility of paying debt charges becomes zero.

The last regular speaker of the evening was Meredith B. Givens of the Social Science Research Council. He stated that, of the nation's labor supply, the proportion engaged in the direct production of physical goods has been diminishing steadily during the last sixty years. In 1870, about seventy-five per cent of the gainfully employed were engaged in the production of physical goods in agriculture, mining, manufacturing, and construction. In 1930, only about fifty per cent were required for such work. Thus fully one-quarter of the working population had been released from physical production pouring into mercantile, financial, and public utility employments and swelling the ranks of the professions and public service.

A weakness of our present system is that workers in commerce and finance cannot be independently self-supporting; they must, perforce, exchange their services for the physical products turned out by other sections of the population. This interdependence is the basis of the unemployment problem of today, a problem more serious than in earlier times because of the congestion and complex social organization of the urban areas in which the unemployed are concentrated.

Dr. Givens called attention to the fact that current statistics showing changes in physical output per employee-hour are frequently misinterpreted. The defect in these figures is that they usually represent only the output per unit of *direct* labor. Since *indirect* labor is steadily becoming more important, the productivity figures, based upon the input of *direct* labor do not reveal the actual productivity of the industrial system. A true picture of productivity would show that the reduction of labor time per unit of product is counterbalanced by the mounting labor cost of distribution and exchange.

In any case, technology is only one cause of reduction in unit labor requirements. Changes in consumption requirements, shifts in market demand, changes in wages, personnel policy, improved organization or morale, and a host of other factors may have a pronounced effect upon productivity. Technological *displacement*, however, does not *per se* lead to *unemployment* unless a number of other relationships having to do with pricing, elasticity of demand, alternative employment opportunity, and other factors are established. Hence, Dr. Givens maintained, the term technological unemployment is probably a misnomer and should be abandoned in scientific discussion.

WILLFORD I. KING, *Secretary*

PROGRESS OF WORK IN THE CENSUS BUREAU

CENSUS OF WEALTH, DEBT, AND TAXATION

In the December issue of the JOURNAL an account was given of the plans for the decennial report on "national wealth, public debt, and taxation." Work

on this report has advanced to the point where the Bureau is beginning to publish the results in a series of state bulletins or reports under the title, "Financial Statistics of State and Local Governments: 1931." These reports give for each state the revenue receipts, governmental-cost payments, public debt, assessed valuations, and tax levies for the Government of the State, and for all counties, cities, towns, school districts, and townships.

Heretofore the results of this decennial inquiry have been published under the title, "Wealth, Debt, and Taxation." But that title, although appropriate, perhaps, when first adopted, has come to be inadequate and misleading. As regards wealth, all that these reports heretofore have contained has been an estimate of the total wealth of the country by states; and it is doubtful whether any such estimate will be included in the present inquiry. No plans have been made for it as yet. The former title is also defective because the inquiry includes a good deal more than public debt and taxation. The new title "Financial statistics of states and local governments" is more truly descriptive of what these reports cover. The statistics will be published in a series of state reports the first of which, that for Indiana, has already been issued. In this connection the Bureau is preparing digests of state laws relating to taxation and revenue which it hopes to publish later, similar digests having been published in connection with the inquiries of 1902, 1912, and 1922.

CENSUS OF ELECTRICAL INDUSTRIES, 1932

The census of electrical industries, which is now in progress, is taken quinquennially. It covers electric light and power stations, electric railways and affiliated motor-bus lines, telephones and telegraphs, and includes such items as equipment, capital and investments, operating revenues and expenses, volume of business, fuel used, employees, salaries and wages.

The schedules, with printed instructions for preparing the reports, were mailed in February and March of this year and were sent to a total of approximately 56,000 establishments. By the close of April returns had been received from about one-half of the establishments.

The statistics of electric railways and affiliated motor-bus lines will reflect in part the transition in public transportation from railway to bus. The census includes not only the motor-bus operations carried on as a part of the electric-railway company's operations or through a subsidiary motor-bus company, or partly through the electric-railway company and partly through a separate company, or carried on by a company controlled by the same interests that control electric railways; but it also includes the motor-bus operations of former electric-railway companies which have abandoned the operation of railway lines and are operating busses exclusively, and also motor-bus systems operated by companies which have succeeded to the operations of electric-railway companies.

Considerable difficulty is experienced in securing reports from farmer and other short service telephone lines, as the line officials do not realize the necessity for making the reports. The returns to date indicate that many small telephone companies have entirely abandoned operations or have been merged with larger companies.

BIENNIAL CENSUS OF MANUFACTURES

The series of preliminary industry reports for the biennial census of manufactures covering the year 1931 was completed and published before the close of the year 1932; and the Bureau has now completed the series of mimeographed state and industrial-area reports, giving statistics by industries. (The industrial areas, as defined for the purposes of the census, are the areas surrounding and including the important manufacturing cities.)

The previous biennial census, taken in 1930 and covering the year 1929, coincided with the decennial census, and for that reason included more detail than is regularly covered by the biennial census. The results of the census of 1929 have now been published in three volumes of the Reports of the Fifteenth Decennial Census. The census of 1931 omits the additional questions contained in the 1929 census, and also makes some reductions as compared with the biennial census of 1927. An unusual degree of interest attaches to the results of the census of 1931 because as compared with the census of 1929 it shows in a striking way the effects upon industry of the business depression.

The Bureau is already making preparations for the next biennial census, which will cover the current calendar year (1933) and will be taken, of course, in the year 1934. It is not unlikely, however, that this may be the last biennial census of manufactures, as serious consideration is being given here in Washington to a proposition to discontinue the biennial census and take instead a quinquennial census but with annual compilations of statistics of production.

J. A. H.

MISCELLANEOUS NOTES

The Association's Program at Chicago.—The American Statistical Association will participate with other social science organizations in sponsoring a number of joint sessions upon the program of the American Association for the Advancement of Science at Chicago, June 19–29, in connection with the Century of Progress Exposition. A joint program committee has been formed under the leadership of Section K of the A. A. A. S., containing representatives of the American Statistical Association, the Econometric Society, the American Sociological Society, the Social Research Society and the Harris Foundation. Several of these organizations will conduct round-table or similar meetings, independently, or in coöperation with other groups, including other sections of the A. A. A. S. These will be scheduled so far as possible during morning hours. The annual lectures upon the Harris Foundation will occur in afternoon sessions, leaving the evenings available for joint meetings which will feature papers by distinguished European guests and American social scientists.

The session of Thursday evening, June 29, will have upon its program Professor Henry Clay of Manchester, one of the Exposition's guests from Great Britain, as well as representatives of the federal administration at Washington. Among other foreign guests who are expected to present papers of social science interest are Professor William Oualid of Paris, Sir Daniel Hall of London, Professor Emilio Mira of Barcelona, Professor Charles E. Spearman of London, Professor G. A. Bagge of Stockholm, and Professor A. Mendelssohn Bartholdy of Hamburg.

Activities of the Committee on Labor Statistics.—The Committee on Labor Statistics has recently been considering technique for the correction of employment indexes. A memorandum on the subject prepared for the Committee by Sidney W. Wilcox, Chief Statistician of the New York State Department of Labor, has been submitted to the members and their comment is now being received. Mr. Wilcox plans to revise his suggested procedure in the light of the members' comment and it will then be further considered in an effort to reach a unanimous recommendation.

It is hoped that this and similar undertakings of the Committee on Labor Statistics will be useful to the Committee recently appointed by Professor Stuart A. Rice, President of the American Statistical Association, at the request of the Secretary of Labor to advise regarding the statistics of the Federal Department of Labor. This Committee has been designated as the "Advisory Committee to the Secretary of Labor, associated with the Committee on Labor Statistics." The members of the new committee, all but two of whom are members of the Committee on Labor Statistics, are as follows:

Morris A. Copeland, Department of Economics, University of Michigan
J. Frederic Dewhurst, American Iron and Steel Institute
Meredith B. Givens, Social Science Research Council
Ralph G. Hurlin, Russell Sage Foundation
Miss Aryness Joy, Division of Research and Statistics, Federal Reserve Board
Howard B. Myers, Division of Statistics and Research, Illinois State Department of Labor
Sidney W. Wilcox, New York State Department of Labor
Bryce M. Stewart, Industrial Relations Counselors, Inc., *Chairman*

Professor Rice has instructed the new Committee to secure the coöperation of the Committee on Labor Statistics and to submit its reports to the permanent Committee for comment and criticism in advance of their adoption by the Advisory Committee.

"Statistical Procedure of Public Employment Offices," by Annabel M. and Bryce M. Stewart, has just been published by the Russell Sage Foundation for the American Statistical Association. It was prepared under the auspices of the Committee on Governmental Labor Statistics and contains a suggested plan for statistical procedure of public employment offices in the United States. The book is particularly timely, in view of the probable enactment of the Wagner bill and the development of the federal Employment Service. The Secretary of Labor, Frances Perkins, has commented as follows on the value of the coöperation between public and private agencies of which this piece of work is an example: "In connection with the publication of this study the value of collaboration between public and private research agencies cannot be too greatly emphasized. It is doubtful if public agencies alone could have undertaken, at least at this time, so complete and meticulous a study." (Obtainable from the Publication Department of the Russell Sage Foundation, 130 East 22nd Street, New York; price, $2.50.)

The Monograph Series of the Association.—By the time this appears the Association will have released the first of its new series of publications. This first volume is *American Agricultural Villages: 1930. An Analysis of Census Data*, by Irving Lorge under the direction of Edmund deS. Brunner. It will be as uniform as possible with Journal, Annals and Proceedings in size and general appearance. Issue price is $1.00, but a special introductory offer will be made to members of the Association.

Inquiries regarding it should be addressed to Secretary Willford I. King, 236 Wooster Street, New York City.

The Albany Chapter.—A dinner meeting was held on March 20 with 38 persons present. The following officers were elected for the ensuing year: President, Dr. R. L. Gillett, New York State Department of Agriculture and Markets; Vice-President, Dr. W. W. Coxe, New York State Department of Education; Secretary-Treasurer, Dr. D. M. Schneider, New York State Department of Social Welfare; Members of Executive Committee, Mr. S. W. Wilcox, New York State Department of Labor; Mr. J. M. Gibson, International Business Machines Corporation.

Mr. G. H. Armstrong, Executive Director of Education of the International Business Machines Corporation, gave an interesting talk on "The History of Machine Tabulation." The Chapter passed the following resolution urging the continuation of certain community services: "The Albany Chapter of the American Statistical Association believes that certain community services are especially necessary during this period of depression and unemployment. It is opposed to the curtailment of such services but realizes in view of economic conditions that the community dollar should be expended most wisely and carefully.

"This Chapter will gladly coöperate in any movement designed to safeguard the alleviation of suffering and need upon an adequate and efficient basis."

The Chicago Chapter.—The Chicago Chapter extends a cordial invitation to all members of the Association in this country or from abroad, who may be visiting the Century of Progress Exposition or attending meetings there, to call upon them. The President or the Secretary of the Chapter will be glad to become acquainted with and assist the visitors, or to put them in contact with other members residing in Chicago, whom they would like to meet. The President, Professor Henry B. Schultz, may be reached at the University of Chicago, Social Science Building, Telephone Midway 0800, and the Secretary, Mrs. Bernice Lamb, at the Federal Reserve Bank of Chicago, 230 South La Salle Street, Room 523, Telephone Harrison 2320, Local 351.

The members and guests of the Chicago Chapter had the opportunity on Thursday, February 2, of hearing Professor Stuart A. Rice, President of the American Statistical Association. He discussed the outstanding gaps and deficiencies in American social statistics and certain proposals for improvement which grew out of the studies of the President's Research Committee on Social Trends, of which committee Professor Rice was a member. Professor Rice indicated that there are many desirable improvements to be made in Federal statistics. However, over-lapping and duplication in the Federal services are not so general as assumed; also, centralization of the data is not so desirable as often thought. Among the major improvements cited that should be made in these statistics was a conscious effort in different departments to secure greater comparability. At present, for instance, it is impossible accurately to compute domestic consumption, inasmuch as the units and classes in production, exports, etc., are not the same. Furthermore, variations in laws in the different states confuse the statistics on marriage, divorce, criminal records, etc. Much improvement along these lines could be accomplished through the conference method, calling all divisions involved and establishing common definitions and classes. A scientific calendar should also be worked out, as calendar errors are also involved in the comparability of the statistics. Another greatly needed improvement in Federal statistics is, according to Professor Rice, a better organization for use of the data already available. The indexing and availability of the Bureau of

other resident of Connecticut who is interested in statistical work. Membership dues are one dollar a year. Meetings will be held at least bi-monthly in approximate rotation in New Haven, Hartford, and Bridgeport.

The Pittsburgh Chapter.—A round table discussion of the probable significance of recent monetary and banking developments was held at our March meeting. The discussion was led by Professor Montfort Jones, of the Department of Finance, and Professor George J. McCabe, of the Department of Economics, School of Business Administration, University of Pittsburgh. These men have been particularly close to the subject in recent months, and were able to present it in a way which provoked much profitable discussion.

New officers elected are as follows: E. C. Stone, Assistant to the President of the Philadelphia Company, President; George A. Doyle, Bell Telephone Company, Vice-President; and T. H. Gerken, resident editor of *The Iron Age*, Secretary-Treasurer.

The San Francisco Chapter.—A dinner meeting of the San Francisco Chapter was held on Wednesday, February 15, as the first of two meetings to consider the question of debt settlements by defaults and reorganizations or by inflating the currency and credit systems.

Refinancing bonded indebtedness in California was the topic discussed at this meeting by Julian C. Whitman, Executive Secretary of the Real Estate Bondholders Protective Committee and of the California Irrigation and Reclamation District Bondholders Association. Mr. Whitman was formerly Assistant to the President of the San Francisco Stock Exchange.

The speaker first compared the extent of debt default in public and private financing, both for California and for the United States as far as figures were available. He then gave attention to a description of the refinancing of irrigation districts, in which field there had been more refinancing in the last year than in any other group, either public or private. He discussed the origin and purposes of the financing, its extent and nature and the relation of debt to the total value of the project. The effect of falling prices on farm products and the nature of the breakdown in the past systems were noted, followed by a review of the different plans adopted in refinancing the different districts in default.

The reclamation district securities were next discussed.

The differences in the legal aspects as affecting both debtor and creditor were pointed out, as well as the differing economic problems which might dictate different types of settlements. Following this, there was a review of the characteristics of the funded obligations of municipalities, counties, schools, and special assessment districts, with their overlapping liens and debt limitations, and their status as affecting the settlements with one class of bondholders only.

The second division of the talk covered corporate refinancing. Illustrations of specific buildings in San Francisco recently taken over by the bondholders were cited, with methods used. Industrial and railroad bonds were enumerated. The problem of the private mortgages as distinguished from corporate or governmental debts was covered at considerable length with conclusions as to the future course of public and private refinancing.

Bondholders as a rule are desirous of securing the greatest net return of their principal, but it does not always follow that they will drive the hardest possible bargain. An apparently favorable settlement, from the viewpoint of the bondholder,

may turn out to be an expensive settlement when the district is later forced into default again, and a second reorganization is necessary. In most public bonds, also, there is no provision for the bondholders to take over the property as in the case of a private bond issue.

The last meeting of the fiscal year was held on Wednesday, April 19, 1933, the day on which the United States officially abandoned the gold standard. The subject of this dinner meeting, at which 60 attended, was Reflation. The speaker was Dr. Carl C. Plehn, Flood Professor of Finance, University of California. Following the paper, there ensued a lively discussion.

Dr. Plehn's remarks may be summarized as follows: Reflation is a term used by *those inflationists* who argue for regulated inflation. Their intent is to raise prices artificially up to some point which to them seems good and then stop, or stabilize.

Aside from the fact that history warns us of the great difficulty of stopping inflation when once begun, there is a grave question as to who shall decide where to stop.

Admitting that the prices of cotton, copper, and wheat are too low for profitable production, can this evil be corrected by raising all prices? Obviously not for they would still suffer the same relative disadvantages.

The complaint that the burden of debt has been increased by deflation is justified but grossly exaggerated. To correct it by reflation while adjusting those debts made during inflation, creates all over again new situations equally bad, with regard to all debts made since deflation began. In this case the creditor is the sufferer and creditors are just as numerous as debtors for there is one for each debt.

There are many bad debts in existence, and these must be written off. Monkeying with the currency won't make a bad debt good. It is a hard doctrine to say to men who are over extended and banks that are over loaned, "take your losses and begin over." But a linseed poultice won't cure cancer.

There is no top to inflation. The sky is the limit. But there is a botton to deflation. It cannot go below the sea level of international gold prices. Like the ocean, gold prices have tides and waves, but after all "sea level" is a pretty stable point.

United States Bureau of Labor Statistics.—In view of the demand for first-hand information on self-help projects among the unemployed, the Bureau made a selective field study of such activities. Reports covering the localities chosen for the survey were published in the March, April, and May issues of the *Monthly Labor Review*.

Data on wages and hours of labor in 1932 were collected by the Bureau for the following industries: Boot and shoe, cotton goods, dyeing and finishing of textiles, hosiery and underwear, leather, lumber, men's clothing, motor vehicle, Portland cement, pottery, rayon and other synthetic yarn, and woolen and worsted goods. Summary data for all of these industries except motor vehicles have been published in the *Review*. In addition to these industrial surveys, the usual annual surveys were made, and figures published, on union wage scales and on entrance wage rates of unskilled labor in various industries. Figures were also collected, by correspondence, on wages paid to common street labor hired by towns and cities having a population of 2,500 and over, and on salaries of policemen and firemen in cities of 50,000 and over. Data on wages and hours are being collected for the glass, iron and steel, bituminous coal, and silk and rayon goods industries, and for foundries and machine shops.

A series of articles on wages in foreign countries in 1932, based on reports furnished by representatives of the Department of State, is being carried in the *Review*, the first article appearing in the March issue.

Information on operations during 1932 under state old-age pension laws is being gathered.

An analysis of the records of 3,315 persons granted old-age allowances in New York State was made by the Bureau, with a view to ascertaining the occupations of these persons during their working years. The results of the study were given in the *Review* for February, 1933.

The bulletin containing the text of Federal and state legislation relating to public and private employment offices, which had been in course of preparation for some time, is being printed and bulletins giving, respectively, court decisions and labor legislation of 1931 and 1932 are practically ready for the printer.

The Bureau of Agricultural Economics.—The Bureau of Agricultural Economics has recently released its estimate of farmers' gross and cash income from farm production in 1932. The report shows that gross income to agriculture in 1932 was $5,143,000,000, cash income $4,201,000,000, and cash expenditures for production $2,899,000,000, leaving $1,302,000,000 of cash available after deducting production expenditures. This compares with $1,934,000,000, the cash available in 1931, and $4,657,000,000 in 1929. The report also shows how farmers have been meeting the decline in income during the past four years by sharply curtailing their expenditures, especially expenditures for machinery, automobiles and trucks, and repairs on farm buildings. This sharp curtailment in the purchase of capital equipment, if it is long continued, will tend to restrict production.

The income available to farmers for their labor, capital, and management fell short by nearly $1,200,000,000 of rewarding the farm family for their labor, even at the reduced wage rates for hired labor. The inventory value of farm property declined over $14,000,000,000, or about 25 per cent, from the spring of 1930 to the spring of 1932, and declined further during 1932.

In this report, the classification of operating expenditures differs slightly from the previous reports. Estimates of operating expenses from 1924 to 1932 are classified separately, according to current operating expenditures, and expenditures for capital equipment. In estimating the cash available each year, after deducting production expenses, the total annual cash outlay is considered, while in estimating income available for the operator's labor, capital, and management, only the cash outlay for current operating expenditures is considered; but, in addition, a depreciation allowance is made for capital equipment.

The Division of Agricultural Finance of the Bureau of Agricultural Economics has submitted for publication by the Department of Agriculture a manuscript relating to farm debt settlements under Federal law. This publication will consist mostly of a statistical summary of the bankruptcy experience of farmers since the enactment of the National Bankruptcy Law in 1898.

Recent publications of statistical data relating to agricultural finance include the following: *Farm Loans of Life Insurance Companies*, by David L. Wickens, giving for each year from 1926 to 1930 new loans and outstanding loans on farm real estate by 226 identical life insurance companies representing 98 per cent of the assets of all legal reserve life companies; *Terms and Conditions of Farm Mortgage Loans*, 1931–32, the third annual report covering conditions of long term farm real estate loans; distributions of encumbered farms on the basis of severity of mortgage debt burden as measured by ratio of debt to value of the property; and *Agricultural Credit Corporations Affiliated with Cotton Marketing Associations*, U. S. Department of Agriculture Tech-

nical Bulletin 322, by W. H. Rowe, a study of the operations of five credit corporations during the period 1924–30.

The Farm Real Estate Situation, 1931–32, by B. R. Stauber, was published in January as U. S. Department of Agriculture Circular 201. The developments of the year are reviewed; and the indexes of average farm real estate values per acre and estimates, by states, of the number of farms per 1,000 changing ownership through mortgage foreclosure, sale for taxes, voluntary sale, and other types of transfer, are brought to date.

An analysis of the tenancy statistics of the 1930 Census has been begun in the Division of Land Economics. Between 1925 and 1930 the first increase of any magnitude since the 90's took place in the proportion of American farmers who do not own the land they operate.

E. O. Wooten of the Division of Land Economics has computed the land areas of continental United States, arranged by major ownership classes, with particular reference to the various categories of land under various types of Federal and state control. These data are given by states.

A statement on income from farm production in the United States, published in the November, 1932, issue of *Crops and Markets*, presents gross income figures for 1930, 1931, and 1932, computed from estimates of production which have been revised on the basis of the 1930 Census. The report contains estimates of the gross income from crops and from livestock, separately, for the country as a whole and for the several states. A more detailed report, with some revisions, will be issued within the next few months.

A multigraphed publication, "Cotton Statistics and Related Data for Agricultural Workers," has been prepared by Lawrence Myers and Maurice R. Cooper of the Division of Statistical and Historical Research, Bureau of Agricultural Economics. This publication presents many of the major statistical series on cotton and the related problems of demand, price level, and alternative crops, found necessary for understanding world cotton economics and appraising cotton situations.

Resolution of the Census Advisory Committee on the Occasion of the Retirement of Director Steuart.—At its meeting on March 18, 1933, the Census Advisory Committee adopted the following resolution on the occasion of Mr. Steuart's retirement from the position of Director of the Census and voted that it be transmitted to the Managing Editors of the Journals of the American Economic and the American Statistical Associations with recommendations that it appear in the forthcoming issues:

> Over a decade ago, with the rich experience already gained by years of service in the Bureau, as Chief of the Division of Manufactures, as Chief Statistician, and as Assistant Director, Mr. Steuart finally assumed full responsibility for completing the Fourteenth Census as Director; and remaining in that office he has now brought to a successful completion the great task of taking the Fifteenth Census.
>
> His administration has been characterized by a broad spirit of coöperation both within the government service, and also with unofficial scientific, social and business organizations. This Census Advisory Committee, under the leadership of the late W. S. Rossiter, and with the help of many able members not now sitting with us, has functioned effectively only because of Mr. Steuart's constant desire to improve and extend the Bureau's activities. To the character and success of his efforts the organization, administration and results of the Fifteenth Census bear eloquent testimony.
>
> The members of the Census Advisory Committee, both as individuals and as representatives of the American Economic Association and the American Statistical Association desire to record their high respect for and appreciation of the

distinguished public service and the notable personal achievements of Director William M. Steuart as he relinquishes, on March 31, 1933, the arduous duties of his office. Furthermore, we assure him of our continued good wishes in all his future activities.

The New Director of the Census.—William Lane Austin, of Mississippi, was appointed Director of the Census on April 6 by President Roosevelt, in place of William M. Steuart who retired on March 31.

Mr. Austin has been connected with the Census Bureau in various positions since 1900. He served as Chief Clerk from 1913 until 1917, when he was made Chief Statistician for Agriculture. He had charge of the 1920 and 1930 decennial censuses of agriculture and of the quinquennial census of 1925; also of the monthly collection of statistics relating to cotton, wool, leather, wheat milling products, hides, boots and shoes, hosiery, clothing, and other key commodities.

Statistical Anniversaries.—Centenary meetings of statistical associations are at hand. The Statistical Society of London, now the Royal Statistical Society, will observe next year, probably in April, the 100th anniversary of its foundation, and at the same time the Manchester Statistical Association, organized a year earlier, will commemorate its establishment. The American Statistical Association, established six years later than its model, the Statistical Society of London, while it is probably the oldest society in the United States devoted to any one of the social sciences, is not the oldest statistical association in the western hemisphere. That distinction belongs to the *Societe Mexicaine de Geographie et Statistique* established in the spring of 1833 and holding its centenary next October.

At the meeting of the International Statistical Institute at Madrid in 1931 the Government of Mexico invited that body to meet in Mexico City, October 11–14, 1933, in connection with the centenary meeting of the Mexican Society and the invitation was gladly accepted. The Mexican Government has agreed to pay not only the usual expenses of the session but in addition the transportation expenses of 56 members of the Institute from their homes to Mexico City and back. It will also defray the railway expenses within Mexico of the families of members who attend the meeting. In addition to providing for the scientific sessions it will arrange for a second week of excursions to a few of the many interesting spots in Mexico.

It is expected that half a dozen members of the Institute from the United States will attend the Mexican meeting. The European members will travel together to Vera Cruz via Havana but return from Vera Cruz via New York.

The Royal Statistical Society has also invited the Institute to meet with it at the time of its centenary meeting next spring. This invitation, which was gladly accepted, was especially welcome because the Institute was founded at the Jubilee Meeting of the Royal Statistical Society in 1885. Details about the arrangements for the London meeting are now being arranged. It is possible to say, however, at this time that a grant of $10,000 has been made to the Institute by an American corporation to defray the expenses of printing the Report of the London session of the Institute.

Census Tract Data for New York City.—The Research Bureau of the New York Welfare Council has taken over the local functions of the Cities Census Committee, which under the direction of Dr. Walter Laidlaw was responsible for bringing about the compilation and publication of federal census data for New York City, and later for other cities, for constant small areas, now known as city census tracts. The

Welfare Council has assumed responsibility for distribution of the publication containing the 1930 census tract data for New York City, and with it is offering the remaining copies of the corresponding 1920 volume. A bargain offer is announced, including for the price of $5.00 the following documents:

> *Population of the City of New York, 1890–1930*, a 310-page book with maps, diagrams and graphs (formerly priced at $10); *Statistical Sources for Demographic Studies of Greater New York, 1920*, a volume of 844 pages, including maps and diagrams (formerly $50); and the Council's map of New York City's health areas, 1930 revision, showing how the census tracts were combined to form the health areas; size, 28 inches by 27¼ inches; regular price, $1.

The Committee on Statistics of the Blind.—This Committee, which is sponsored jointly by the American Foundation for the Blind and the National Society for the Prevention of Blindness, has continued work on the development of a standard classification of the causes of blindness. Its proposed classification, which provides for distribution both etiologically and topographically of assigned causes of blindness, and which conforms to the terminology recommended by the National Conference on Nomenclature of Disease in its recently published *Standard Classified Nomenclature of Disease*, was presented for discussion at the recent annual meetings of the American Medical Association at Milwaukee and the International Association for Prevention of Blindness at Madrid. Copies of the proposed standard classification can be obtained by interested statisticians by addressing the secretary of the committee, Miss Evelyn C. McKay, 125 East 46 Street, New York.

The Social Work Year Book.—Dr. Fred S. Hall is editor of the *Social Work Year Book—1933*, published in April by the Russell Sage Foundation. This is the second edition of this reference book, the first having been issued in 1929. The book describes activities of more than 100 distinct departments of social welfare and closely related fields, and contains a directory and brief description of all important national welfare agencies, both public and private, as well as a directory of state governmental departments and agencies in the fields of public welfare, labor, health, and education. There is also a 2500-word article on the present status of statistics of social work by Ralph G. Hurlin.

Econometrica.—Publication has been announced of a quarterly journal of the Econometric Society. Two issues of Volume I have appeared under dates of January and April, 1933. Ragnar Frisch of the University of Oslo is Editor; Alvin H. Hansen of the University of Minnesota, Frederick C. Mills of Columbia University and Harold T. Davis of Indiana University are Associate Editors; William F. C. Nelson of Colorado College is Assistant Editor; and Alfred Cowles 3rd, Director of the Cowles Commission, Colorado Springs, Colorado, is Circulation Manager.

Seminar in Social Science Research in Paris.—The College of Liberal Arts of Northwestern University has announced the third year of this Seminar under the auspices of the University of Paris, June 15 to July 31. It is designed to guide and aid students and traveling fellows in the utilization of research facilities in Paris and its environs. Each member of the Seminar is expected to work on a special problem of his own choosing and to present reports which are criticized from the point of view of form, content, methodology and theoretical implications. The proceedings are in English. The Seminar is open only to graduate students having a reading knowledge of French. Professor William Jaffé is again Director of the Seminar.

PERSONALS

Mordecai Ezekiel Appointed Economic Adviser to Wallace. Secretary of Agriculture Wallace has appointed to the newly created post of Economic Adviser in his office Dr. Mordecai Ezekiel, formerly of the Bureau of Agricultural Economics, and since 1930 Assistant Chief Economist of the Federal Farm Board.

While on the Federal Farm Board staff Dr. Ezekiel was on leave for a year and studied in Europe under a Guggenheim Fellowship, devoting his attention to the problems of economic organization in the major European countries.

Dr. Ezekiel joined the department in 1922 and earned rapid promotion on the basis of economic and statistical research and analysis. He is the author of several departmental publications, and many articles both popular and technical, as well as a statistical textbook, "Methods of Correlation Analysis." He has specialized in the problems of adjustment of agricultural production to demand and has helped develop the agricultural outlook service of the Bureau of Agricultural Economics.

As Economic Adviser to Secretary Wallace he will continue to deal with the problems of the economic readjustment of American agriculture.

Dr. Dorothy Swaine Thomas went in March to Stockholm where she is spending the summer doing research at the Social Science Institute. She is holding a seminar at the University on "The Sociological Approach to Behavior Study."

Major P. Granville Edge has recently returned to the London School of Hygiene and Tropical Medicine from Shanghai, China, where he has been organizing a new Division of Medical Statistics in the Henry Lester Institute of Medical Research.

OBITUARY NOTES

Thomas S. Adams, professor of political economy at Yale University, author of many of Wisconsin's tax laws and for many years adviser to the Federal Treasury Department, died February 8 of pneumonia.

Professor Adams had been associated with Yale from 1916. From the time of the Wilson Administration he had been regarded as a spokesman for the Treasury Department before Congressional committees. He was president of the National Tax Association, 1922–23, and in 1927 was elected president of the American Economic Association. He had been a member of the Fiscal Committee of the League of Nations from 1920.

He was born in Baltimore, December 29, 1873, and was graduated from Johns Hopkins in 1896. In 1899 he was appointed a clerk in the Census Bureau and in the next year was named assistant to the Treasurer of Puerto Rico.

Professor Adams joined the faculty of the University of Wisconsin in 1901, and served as Tax Commissioner of that State from 1911 to 1915. He also had served on the faculties of Washington University and Cornell. He was appointed an adviser to the Treasury Department in 1917, tax problems being his special field. He was the author of a number of authoritative works on labor, tax and economic problems.

Thomas Henry Craig Stevenson, born at Strabane, Co. Tyrone, in 1870, and educated at University College, London, died in September, 1932. He graduated as M.B. Lond. in 1890, later going on to the M.D. in State medicine and the D.P.H. Camb. He married, in 1900, Ella Louise, daughter of Mr. Samuel Sillifant, and left one son and one daughter. He served from 1905 to 1908 as assistant educational medical officer to the London County Council, and then for a short period as school medi-

cal officer in Somerset. In 1900 he was appointed superintendent of statistics in the General Register Office; and in that capacity, or under the substituted title of medical statistical officer, he served until his retirement in 1931. During the War he was a member of the reserve occupation and enemy personnel committees; and for these and other war services performed in the General Register Office he was created C.B.E. in 1918. He was a Fellow of University College, London; Fellow, Guy (gold) medallist, and formerly honorary secretary of the Royal Statistical Society, honorary member of the American Statistical Association, and Jenner medallist of the Royal Society of Medicine. Quite recently he was awarded the Bisset Hawkins gold medal by the Royal College of Physicians.

This bare chronicle of services and distinctions affords no indication of the real value of the work which Stevenson performed during his official career at the General Register Office. This must be measured, not only by the individual value of his many brilliant pieces of research, but by the less visible merit of his steady contribution to the maintenance and enhancement of high standards of scientific sincerity and thoroughness.

COMMITTEES

The *Committee on Fellows* elected the following:
Robert B. Warren
as a Fellow in the American Statistical Association.

In the March, 1933, Proceedings volume, the *Committee on Statistics of Delinquents and Criminals* was inadvertently omitted from the list of research committees of the Association. Its membership is as follows:

Thorsten Sellin, *Chairman*	Bennet Mead
Leon C. Marshall	Edwin H. Sutherland

The chairman is an associate member of the Committee to Stimulate and Coördinate Research.

ADDITIONAL COMMITTEE APPOINTMENTS

Advisory Committee to the Secretary of Labor (associated with the Committee on Labor Statistics)

Bryce M. Stewart, *Chairman*	Ralph G. Hurlin
Morris A. Copeland	Miss Aryness Joy
J. Frederic Dewhurst	Howard B. Myers
Meredith B. Givens	Sidney W. Wilcox

Three new members added to the *Committee on Statistics of Relief and Child Care*

Maude E. Stearns	Frederick Stephan

Helen L. Witmer

MEMBERS ADDED SINCE MARCH, 1933

Barnard, Lynn L., Granada Hotel, 1000 Sutter Street, San Francisco, California

Baxter, J. Morton, Investments, DuPont Building, Wilmington, Delaware

Beckman, C. J., Commission of Labor and Industry, State of Kansas, State House, Topeka, Kansas

Beville, Hugh M., Jr., Assistant Chief Statistician, National Broadcasting Company, Inc., 711 Fifth Avenue, New York City

Campbell, Francis F., Freeport Sulphur Company, 122 East 42nd Street, New York City

Clapp, Mary A., Director, Bureau of Research Studies, Boston Council of Social Agencies, 43 Tremont Street, Boston, Massachusetts

Coutant, Frank R., Director of Research, Pedlar and Ryan Inc., 250 Park Avenue, New York City

Dorn, Harold F., Graduate Student, Department of Sociology and Anthropology, University of Wisconsin, Madison, Wisconsin

Doyle, Bertram W., Department of Sociology, Fisk University, Nashville, Tennessee

Haley, Dr. B. F., Research in Economics, Stanford University, California

Harper, A. S., Investment Counsel, 122 East 42nd Street, New York City

Hartley, George, Room 1104, 117 Liberty Street, New York City

Haynie, Charles W., Statistician, Institute of Carpet Manufacturers of America, Inc., Chrysler Building, New York City

Henninger, Leonard L., Graduate Assistant and Research Student, Department of Psychology, Ohio University, Athens, Ohio

Hostutler, Hoyt, Retail Credit Company, 420 Lexington Avenue, New York City

Hughes, Alva F., Stock and Bond Brokerage, 120 Broadway, New York City

Johnson, Kenneth, Farmer's and Merchant's National Bank of Los Angeles, Los Angeles, California

Jones, Allen N., Statistician, J. P. Morgan and Company, 23 Wall Street, New York City

Kilgore, Bernard, News Editor, The Wall Street Journal, 44 Broad Street, New York City

Logan, Robert R., Instructor, Lake Forest College, Lake Forest, Illinois

Lough, William H., President, Trade-Ways, Inc., 285 Madison Avenue, New York City

Matheson, Kenneth G., Jr., Drexel Institute, Philadelphia, Pennsylvania

Matz, Milton, Research Associate, Bureau of Research, New York State Department of Social Welfare, Albany, New York

Meyers, Bernard, 341 Powell Street, Brooklyn, New York

Mooney, Will H., Indianapolis Abattoir Company, Indianapolis, Indiana

Myers, Dr. Aaron H., Research Assistant, Bureau of Research, New York State Department of Social Welfare, Albany, New York

Neusitz, Ralph E., Advertising and Market Research, Globe-Democrat, 1133 Franklin Avenue, St. Louis, Missouri

Oliphant, Alfred W., Jr., Assistant in Business Statistics, University of Texas, Austin, Texas

Pabst, William R., Jr., 120 Liberty Street, New York City

Peter, Paul F., Chief Statistician, National Broadcasting Company, 711 Fifth Avenue, New York City

Pingree, Daniel, Fire Insurance, 815 Grosvenor Building, Providence, Rhode Island

Reynolds, Charles S., Statistician, Hoffman Beverage Company, 402 Grove Street, Newark, New Jersey

Ryder, Vernon C., Lawyer, 21 West Street, New York City

Schmid, Dr. Calvin F., Assistant Professor of Sociology, University of Minnesota, Minneapolis, Minnesota

Selbert, Mrs. Frida F., National Machine Tool Builders' Association, 1220 Guarantee Title Building, Cleveland, Ohio

Sokolove, Henri, Research, 210 South 45th Street, Philadelphia, Pennsylvania

Solomons, Leonard M., Student, Columbia College, New York City

Thomson, Chester P., 300 Clinton Place, Hackensack, New Jersey

Thorne, G. B., Bureau of Agricultural Economics, United States Department of Agriculture, Washington, D. C.

Van De Mark, Percy F., Leonard Street, Amsterdam, New York

Vinton, Warren J., Assistant Secretary, American Association for Old Age Security, Inc., 22 East 17th Street, New York City

Watt, Arthur C., The Commonwealth and Southern Corporation, 20 Pine Street, New York City

Wershil, Philip B., 9924 Foster Avenue, Brooklyn, New York

Wilder, Marian, Assistant in Biometry, University of Minnesota, Minneapolis, Minnesota

Norman, J. Van Dyke, Jr., Brokers and Investment Bankers, J. J. B. Hilliard and Son, 410 West Jefferson Street, Louisville, Kentucky

REVIEWS

Fertility and Reproduction. Methods of Measuring the Balance of Births and Deaths, by Robert R. Kuczynski. New York: Falcon Press. 1932. 94 pp.

That crude birthrates are by no means a satisfactory measure of fertility has long been recognized. In this book the author aims to give any reader familiar with elementary arithmetic an introduction to more adequate methods of measuring fertility and reproduction. How well does he succeed? The first three chapters, which are largely a rewording of parts of the first three chapters of the first volume of his *The Balance of Births and Deaths*, deal with "Birth Rate and Fertility Rates"; "Total Fertility and Gross Reproduction Rate"; and "Net Reproduction Rate." The treatment is somewhat prolix and not always as clear as might be desirable in an introduction to the subject, but otherwise there is nothing in these chapters to which exception need be taken.

In Chapter IV the author takes up the rate of increase and birth rate of a stable population. That his own understanding of the subject is not altogether clear may be inferred from his statement on page 23.

> It is evident, therefore, that if a population is constantly subject to a certain mortality (in each year of age), and if the number of births constantly equals the number of deaths, this population, whatever may be its present age composition, will sooner or later have an age composition corresponding to that of the life table and from then on will forever preserve this age composition.

But with changing age distribution the birth rate cannot in general be constant unless there are at the same time compensatory changes in the age-specific fertility of a most improbable character, and if we assume these changes it does not necessarily follow that the age composition sooner or later will become that of the life table. The beginner is likely to have enough difficulties in understanding the relations of demographic variables without having unnecessary obstacles put in his path. Nor will his bewilderment be lessened when he learns from the table on page 33 "Balance of Female Births and Deaths in the Ukraine, 1926–1927" that the rate of increase of the stationary population is 13.84. Surely the rate of increase of a *stationary* population should be zero. This is typical of the loose phraseology of the book.

In his discussion on pages 26 and 27 of the computation of birth rates, death-rates and rates of increase one might have expected that such a scorner of "complicated mathematical methods" would have pointed out that, while in his example the average population, obtained by a formula involving the use of natural logarithms, is 1,000,970, a result correct to within one in 30,000 is obtained by the much simpler use of the arithmetic mean of the population at the beginning and end of the year.

Chapter V, "Reproduction Rate for Both Sexes," is apparently inspired by the remark of Lotka in his review[1] of Kuczynski's *The Balance of Births and Deaths*, Volume I, that in countries in which there is a temporary excess of females, due to war or other causes, net reproduction rates based entirely on the

[1] This JOURNAL, September, 1929, pp. 332–333.

female fertility rates are apt to be misleading, since the low fertility of the females is due in part to temporary lack of husbands for the females to marry. In none of Kuczynski's earlier books, so far as the reviewer can find, is the reproductive rate for both sexes discussed. In the present volume a chapter is devoted to it, but no acknowledgment is made of Lotka's suggestion.

Out of the 94 pages of the book 52 are devoted to an appendix. Six pages of this give an account of the work of Bortkiewicz, while the remainder is taken up with extracts from the paper of Dublin and Lotka, "On the True Rate of Natural Increase,"[1] annotations thereon by Kuczynski and a numerical test of their results. In view of the fact that a numerical test formed part of the original paper, this seems a work of supererogation. It should also be pointed out that the essential features of Bortkiewicz's paper of 1911 had already been published by Lotka in 1907 and that the determination of the *stable* age distribution was solved, not by Bortkiewicz, but by Sharpe and Lotka. Indeed there is an unfortunate tendency throughout the book to slight the fundamental work which Lotka has done on this subject.

On page 57 the value of β given in the Explanatory Remarks should be negative. As may be seen from formula (17) on page 56, β is of the nature of a standard deviation with the sign reversed. Now the standard deviation is necessarily positive and therefore β is necessarily negative. It should also be noted that footnote 20 on page 63 is somewhat misleading. The differences between the rates of increase given in Dublin and Lotka's note in the *Statistical Bulletin* of the Metropolitan Life Insurance Company of January, 1930, and those in their paper in *Metron* are due to the latter figures being corrected for immigration. If Dr. Kuczynski had read the *Metron* paper with more care he might have seen this for himself.

John R. Miner

Johns Hopkins University

The Canadian Grain Trade, by D. A. MacGibbon. Toronto: The Macmillan Company of Canada Limited, at St. Martin's House. 1932. 503 pp.

This book contains an excellent, authoritative exposition of *wheat marketing within Canada* in the decade of the 1920's, and especially about 1930. The author is a former professor of political economy at the University of Alberta, who served on the Royal Grain Inquiry Commission of 1923–24 and has been since 1929 a member of the Board of Grain Commissioners for Canada. In Part II, the core of the book, the wheat movement is followed from country elevator to domestic mill or port terminal, with due consideration of handling, transportation, inspection and weighing, the grain companies, the Winnipeg Grain Exchange, the wheat pools, financing, and public regulation. Some related aspects are discussed in the last chapter of Part I, which brings the historical treatment through the war and post-war periods; in Part III, which deals briefly with the milling industry, the export markets, and conditions of production; and in the Appendix on the new Hudson Bay route.

[1] This JOURNAL, September, 1925, pp. 305–330.

Because of its bearing upon the utility of the work for economists and statisticians, the reviewer feels it pertinent to indicate also what the book is not and indeed does not pretend to be. It is not analytical in character, and does not attempt to grapple seriously with numerous questions of principle and policy. It is not what may be called, by way of compliment or reproach, a scholarly work. The historical portions are sketchy, for the most part admittedly so. The author did not undertake to cover the literature of the subject, much of it readily available. Few references to sources are given, either for general discussions or specific statements, and those cited are sometimes ill chosen. The use of statistics is for the most part casual and informal rather than careful and systematic. There are relatively few text tabulations and no maps, statistical charts, or appendix tables. Where a series of data over a considerable period of years is essential to give a clear picture in due perspective, figures are usually given for one year, a few specific years, or an average for some brief period. There are occasional serious slips in a quotation or in data given.

Within the range of the author's primary interest, most of these limitations are not serious; but in the historical discussions, the consideration of the export trade, and other portions of the book they lead to undue subordination, significant omissions, and occasional misstatements of facts and factors in the Canadian grain trade.

A few diverse illustrations will suffice. The treatment of the Corn Laws in their bearing on Canada (pp. 11–13, 401) is not dependable. In quoting (p. 24) from Professor Mavor's report to the British Government (written in 1904, not in 1906) the word "quality" is used instead of "quantity." The wheat production statistics cited for recent years (p. 75) are apparently for the world including Russia (subject to revisions since made) while the acreage data cited are for some unidentified area far less comprehensive.[1] "Trade estimates" of world import requirements and exportable surpluses for 1930–31 are cited (p. 76) as 730 and 1,170 million bushels respectively, which are Broomhall's figures; but in saying, "Current estimates (July 1931) place the surplus at 1,910,000,000 bushels," the author apparently made a slip, for Broomhall's estimate for 1931–32, at its maximum published November 18, 1931, was 1,010 million bushels. The author represents that "Falling prices act as a check upon over-production by reducing acreage . . ." (pp. 444, 434), and that Canadian wheat acreage was reduced by 8 per cent in 1931 (p. 460); yet official estimates (perhaps not available when the proofs were read) show increases from 24.0 million acres in 1930 to record heights of 26.1 million in 1931 and 27.2 million in 1932.

Within limits, therefore, the book is a valuable contribution to the understanding of the Canadian grain trade; where it goes beyond description of the internal

[1] The acreage figures cited compare as follows, in million acres, with the Food Research Institute's summary of official data for the same years (*Wheat Studies*, December 1932, IX, 115), taking the 1926–28 average for the U.S.S.R. since comparable 1924 data are not available:

Years	*As cited*	*World ex-U.S.S.R.*	*U.S.S.R.*	*Total*
1924–28 av.	172	227.6	(70.7)	(301.3)
1928	161	242.1	68.5	312.8
1930	178	247.5	80.5	328.0

marketing process and its regulation, it may be usefully consulted but cannot be depended upon.

Joseph S. Davis

Food Research Institute,
Stanford University

Ohio Criminal Statistics, 1931, by Alfred Bettmann, W. C. Jamison, L. C. Marshall, R. E. Miles. Baltimore: The Johns Hopkins Press. 1932. 189 pp.
Comparative Judicial Criminal Statistics: Six States, 1931, by Leon C. Marshall, assisted by Elva L. Marquard. Baltimore: The Johns Hopkins Press. 1932. 61 pp.

The first of these two studies, *Ohio Criminal Statistics, 1931*, "was undertaken to test the feasibility of a comprehensive report on criminal statistics in the state of Ohio." It is a joint product of the Institute of Law of Johns Hopkins University and the Ohio Institute. The Bureau of Social Hygiene, Inc., helped out with some money. Data on the work of the juvenile courts and of probation agencies are not included but there are statistics of offenses or offenders from the police, the minor and higher courts and from penal and correctional institutions all combined in the one volume.

The machine of criminal justice is a tremendously complicated affair. In Ohio, there are "more than 2,000 courts of the justices of the peace, more than 800 mayors courts; nearly two score police courts and municipal courts with criminal divisions; and, prior to January 1, 1932, 88 probate courts." In addition, there are 88 common pleas courts of general jurisdiction, one for each county. The policing agencies "consist of the police departments of the 110 cities and the 752 villages, the sheriffs of the 88 counties, and the constables of the 1,337 townships." Ohio has two state prisons, two state reformatories, six workhouses, eighty-eight county jails and some city jails. Then there are the probation departments in certain counties and cities. The task which the authors set for themselves can really only be appreciated by those who have had occasion to look over the records or what purports to be records of similar units of a state machine of criminal justice. The financial resources of a Croesus coupled with the wisdom of a Solomon would be insufficient, the authors insist, to present a true picture of the administration of criminal justice for the courts alone in Ohio. But fortunately, the city police departments and the county sheriffs had already started to send reports to the United States Department of Justice in accordance with the plan developed by the International Association of Chiefs of Police.

Manifestly only a beginning could be made in the task of rendering an account of the work of all these various agencies. But the job has been well done, full utilization having been made of all that has been accomplished recently in the field of criminal statistics. The authors are modest in drawing conclusions so that in reading the report one is fully conscious of the fact that it was prepared by scientists and not by the usual official statistician. One thing stands out above all else, namely, the huge amount of careful statistical planning and foundation work that needs to be done in each state in the realm of judicial criminal statistics.

Some interesting facts are brought out in the tables, many of which serve to

confirm the findings of the state crime surveys. Omitting cases handled by traffic bureaus, there were 277,000 defendants of which 260,000 were handled by the minor courts! In the common pleas courts, one-third of the defendants were eliminated without conviction (50.5 per cent by the grand jury and 21.9 per cent by the prosecutor). Pleas of guilty accounted for 86.2 per cent of those found guilty, trials for only 13.7 per cent. Fifty two and six-tenths per cent of those found guilty in the common pleas courts were sent to prison; 29 per cent were placed on probation or given a suspended sentence, in spite of the fact that probation exists in practice in only a few counties. Local jails or work-houses received nine-tenths of all commitments from all the courts, and over half of these for failure to pay fine. Parole is the common method of release from state prisons and reformatories, 85 per cent being released in this way. Incidentally it is interesting to note that 46 per cent of all persons turned over to the court for prosecution by the police were charged with some violation of the liquor laws.

The second volume, *Comparative Judicial Criminal Statistics: Six States*, is an experimental study of the judicial criminal statistics of Ohio, New Jersey, Iowa, Maryland, Rhode Island and Delaware. Various other experimental surveys, including the Ohio report previously discussed, furnished the raw material for this comparative study. The data were confined entirely to the courts of general criminal jurisdiction, yet the tables include some 45,265 defendants. The offense classification used was that given in *Uniform Crime Reporting*.

The caution shown in the Ohio study is manifested in interpreting the figures and every effort is made to put the reader on his guard. Altogether it is an interesting and worthwhile effort to try out the slowly developing technique of judicial criminal statistics.

The establishment of guilt by jury trial seems to be fast disappearing. In Maryland, pleas of guilty accounted for 61.5 per cent of those found guilty; *in no other state was this percentage less than 80.2*; and in Rhode Island actually 98.7 per cent of convictions were on plea of guilty. In Cape May county, New Jersey, 99 per cent of those convicted were by plea of guilty; and in one of the counties of Ohio this was 100 per cent! The importance of the prosecutor looms up in every state. In Delaware, for example, 73.7 per cent of all eliminated without conviction could be traced to action of the prosecutor. But in Maryland those eliminated by the prosecutor amounted to only 25.1 per cent, a percentage far below that of any of the other five states. The author found, however, that there was great diversity in the methods of elimination within a state. About one-half of those found guilty in the six states were incarcerated, though only one-fourth in Rhode Island. Naturally the percentage of those incarcerated varied greatly with the nature of the offense. Money penalties were common for violations of the liquor laws.

Comparative judicial criminal statistics, the author states, should be regarded for some time to come as a research activity. The reviewer believes that through studies carried on in this spirit we will discover the problems involved in creating adequate criminal statistics for the United States.

Louis N. Robinson

War Debts and World Prosperity, by Harold G. Moulton and Leo Pasvolsky. Washington: The Brookings Institution. 1932. xx, 498 pp.

This book, which is presented (p. ix) as a "synthesis" of all the "previous works in this field" by the Institute of Economics, is obviously intended, to perhaps even a greater extent than other publications by the Institute, for a popular audience. Judged from this point of view, it is altogether admirable; and when one adds that, despite the authors' obvious attempt to keep the quality of the theoretical discussion down to the level of the "general reader," there is little in the volume to which the professional economist can take exception, it is clear that the authors are to be congratulated upon their achievement. Chapter II, for example, on "The Economics of International Payments," if it leaves out most of the subtleties which are familiar to professional students of the problem of international debt-payment, at least does not carry its simplification to the point of misrepresentation. Economists who have quarreled in the past with Messrs. Moulton and his collaborators on certain of the theoretical issues involved will have to content themselves with attacking, not the authors' formal statement of the problem of international debt payment, but the implications which may be inherent in certain of their *obiter dicta*—as, for example, when the authors suggest that no special significance, for the theoretical problem of international debt-payment, attaches to the obtaining of an export surplus by means of "extraordinary measures for restricting non-essential imports and for forcing exports by dumping processes and by drastic reduction of wages, interest rates and domestic prices" beyond the fact that this was a "depression phenomenon" (p. 306).

For the authors' skill in avoiding the temptations which lie so near at hand when one sets out to develop a "popular" argument for modification of the debt-settlements, one can have only admiration. One set of explosives is neatly side-stepped by the authors' decision to avoid "appraising the capacity either of Germany or of the Allied debtors to make payments" (p. 401). They do not assert more, with respect to the conclusions to be drawn from the breakdown of the debt payments, than that "the existing debt settlements were no longer capable of fulfillment *under the conditions in which the world found itself in the summer of 1931*" (p. 324; italics mine); and, in general, their discussion of "capacity to pay," aside from the general aspects of the question discussed in Chapter II, already referred to, does not go beyond the observation that "the capacity of the debtors to pay depends in a vital way upon the capacity or willingness of the creditors to receive" (p. 401).

Much the same may be said of their answer to the question "Would collection of these inter-governmental debts be economically beneficial to the creditor countries?" (pp. 5, 369). For example, the authors do not themselves hold up the bogey of the "flood of German exports" into the markets of Germany's creditors as a reason for cancelling the debts. They content themselves rather with the statement that "*the Allies* have been . . . concerned about a possible flood" of this kind (p. 389; italics mine); and, in general, they are satisfied to confine this part of their argument to a demonstration of the proposition that "the governments of the creditor countries, while

officially committed to the principle of debt collection, have not, in fact, pursued economic policies based on a belief that the receipt of unlimited reparation and Allied debt payments would promote their own economic welfare" (p. 386). When the authors, appearing to speak, not in the name of the creditor governments, but on their own behalf, stress the fact that insistence upon payment would affect our export trade adversely (pp. 406 ff., 411 f.) they might seem to be treading on more slippery ground. After all, the same type of argument, pushed to its logical conclusion, would indicate that no nation should ever attempt to collect its debts! The day is saved, however, by a transference of emphasis to the effects upon our export markets, not of the debt payments per se, but of the "financial instability and consequent social and political unrest" which might follow in Europe from a "pressure for payments" (p. 412) and to the fact that the difficulties of trade adjustment that would come about from a shift from production for export to production for the domestic market, such as would be inevitable if we were to receive "the annual charges on American *private* investments abroad," would be "*much greater* . . . if the war debt payments were also taken into account" (p. 414, italics mine).

One is compelled to admire, finally, the air of objectivity with which the mass of facts marshalled in this volume are presented. The reparations demands at Versailles of the French and of Hughes of Australia are contrasted, for example, with the limitations demanded by the American delegates, as merely representing "two points of view" in the matter. The same may be said with respect to their treatment of "the question whether or not it was possible for Germany to balance her budget" during the period of reparation fulfillment (pp. 283, 303 ff.). Needless to say, a judgment with respect to the truth of certain allegations is often involved in what seems to be a perfectly objective statement of fact—as, for example, when the failure of the Credit-Anstalt is regarded as the result not, as some would have it, of the machinations of French financial diplomacy, but "in a large measure . . . of general financial difficulties in Austria" (p. 309). Occasionally, the objective statement of fact suggests that the authors are not above the use of a sly irony—as when, in addition to calling attention to the fact that "it has been the consistent policy of the American government to regard the reparation payments and the war debts as totally separate and distinct obligations" (pp. 321, 324) they suggest—and support the suggestion with citations—that "the economic connection between reparations and debts has also long been appreciated by responsible spokesmen of the American government" (p. 207).

There is a set of statistical appendices which enhance still further the claim of the volume to be regarded as the most compact collection of data on the war-debts which is now available.

Arthur W. Marget

University of Minnesota

The Purchase of Medical Care through Fixed Periodic Payment, by Pierce Williams, assisted by Isabel C. Chamberlain. New York: National Bureau of Economic Research, Inc. 1932. 308 pp.

Some fifteen years ago, immediately following upon the sensational achievements of workman's compensation legislation, which in some five years spread almost through the entire land, there appeared a very active movement for health insurance, "the next step in social progress." Its protagonists were quite certain of its early victory. But for the catastrophe of the World War they might have been right. However, when man proposes, the god of war often disposes. The collapse of the movement for health insurance in the United States may well be included among the war losses, albeit the actual cost in dollars and cents is difficult to appraise. Moreover, the War was not the only difficulty which the movement had to face. There was organized opposition from several interested groups, such as employers' associations, the medical profession, and above all, private insurance companies. So complete was the collapse that for ten years or more even the phrase almost disappeared from American economic writing, except in its application to the commercial business of accident and health insurance.

But social problems are not so easily disposed of and the cost of medical care —one aspect of health insurance—continued to remain a problem. Some five years ago a Committee on Costs of Medical Care was organized, with a five year plan of research, by a group of physicians, public health men, students of social problems and similar groups. The organization of the Committee was viewed with somewhat doubtful enthusiasm by those who had been actively advocating a health insurance scheme, for fear that the main result of the Committee's work would be unnecessary delay in action. In the meantime, another grave crisis confronted the American people, as well as the world at large, and the energy and interest of advocates of social legislation were diverted away from health and toward unemployment. It might well seem that the Committee on Costs of Medical Care could find no less propitious moment for its final report than the end of 1932 because of the concentration of public attention upon the grave problem of feeding and maintaining, through public and private relief, perhaps a fifth or sixth of our entire population. If there is to be an early "next step in social progress," particularly in the line of social insurance, it is bound to be rather in the field of unemployment than in sickness or in health. That in face of such unfavorable circumstances the final report of the Committee did command so much attention from the medical groups, from economists and from the public at large, is strong evidence of how acute the problem of medical costs has become.

The study of Mr. Williams and Miss Chamberlain was made under the auspices of the National Bureau of Economic Research but upon request and in coöperation with the Committee on the Cost of Medical Care and thus may be properly considered as one of the reports of that Committee. It is a very painstaking and laborious compilation of all available information as to the extent of what might rather loosely be defined as "medical insurance" or "insurance of medical care," but which the authors quite properly have pains-

takingly and accurately described as *The Purchase of Medical Care through Fixed Periodic Payment.*

Curiously enough, this very praiseworthy precision of definition in the title is abandoned in the very first sentence when we are informed that medical care "may be purchased in either of two ways: through direct payment or through insurance." Of course, the definition of the term "insurance" is subject to considerable latitude and flexibility and such flexibility may not be undesirable in this country, where the concepts of social insurance have not yet been sufficiently popularized and where the word "insurance" immediately conjures a picture of millions of assets and at least a twenty-five story tower. Yet, an interesting problem still remains: whether any coöperative scheme to arrange for the furnishing of services is necessarily to be described as "insurance." Insurance is always an arrangement for the distribution of loss, for compensation of loss. In a sense, of course, all insurance, and particularly social insurance, may be considered as a form of coöperation, but all coöperation need not assume the form or be subject to limitations of the insurance process.

A very interesting chapter, which may be warmly recommended to every reader, is devoted to the description of "the American campaign for compulsory sickness legislation." Here again, whoever is responsible for the page headings, showed proper appreciation of this story, for these page headings read, "The Unsuccessful Campaign for Compulsory Insurance," and such it was, as the reviewer knows but too well and to his sorrow. It is perhaps the only available story of this sad chapter in American social progress. In that campaign, following European precedence, the money benefit for loss of wage through illness was intimately combined with a system of providing medical and surgical aid. As the reader undoubtedly knows by this time, the Committee on Cost of Medical Aid, which divided itself into many groups and sub-groups in their relation to the question of health insurance, was fairly unanimous in isolating the problem of medical cost and leaving the question of money benefit for wage loss out of consideration. This division, somewhat artificial perhaps in the light of European experience, has been followed in the book. Even in chapter eleven, dealing with commercial assistance and health insurance, it is only the medical and hospital benefits that are discussed.

The amount of work which the volume represents must, indeed, have been prodigious, even though, as we are told in the preface, "the material . . . was gathered chiefly by correspondence." There is, of course, no system in the United States or perhaps, which is the same thing, there are too many different systems, large and small, good and bad (mostly bad) but at any rate, all different. There are, for instance, the long established plans antedating workman's compensation, in mining and lumber industries of the Pacific Coast, largely due to the isolation of the plants, which made some arrangement for medical aid of the labor force absolutely necessary. Because of the primitive character of our labor laws when these industries had sprung up, the furnishing of medical aid was not made a part of the labor contract and so the cost of it was shifted back upon the workers and sometimes made the method of subtle or crude exploitation. Somewhat similar systems exist in a substantial number

of important trunk line railroad systems, in the metal and coal mining industry of the Rocky Mountains, in some central states and in the Appalachian region. Other coöperative methods, somewhat in the nature of experiments, are private group clinics, which have undertaken to furnish medical services in return for the fixed periodic payments. In two New England communities non-profit associations were founded, offering medical and hospital care to members of the community in return for regular payments of dues. These assume more closely the character of a voluntary insurance scheme. There are a few non-profit community hospitals. There are the systems in existence in a number of state universities, where the students receive medical care in return for a modest periodical payment. Naturally, with that variety of forms of organization, without any obligation to furnish statistical or other reports, any application of the statistical method would have been well nigh impossible. The volume is, therefore, quite strikingly devoid of any tabular material, except an occasional statement as to the number of people concerned or protected. A rough estimate places the number of employees of mining and lumber companies covered by some form of plan, at 540,000, and the number of employees in railroad with hospital associations at some 530,000, so that the total number of employees who in 1930 were protected by some form of "medical insurance" is a little over a million. Not unlikely because of the reduction of the labor force in these industries, the number since then has shrunk considerably. The number of those benefiting from all other plans is probably quite insignificant and perhaps the most eloquent lesson to be derived from this painstaking study is how hopelessly inadequate and inefficient is this method of voluntary group cooperation without any government control or compulsion to meet a serious social and economic problem.

In the recent discussion of unemployment insurance, a good deal was made by the opposition of the absence of the necessary statistical and actuarial data, upon which scientific rate computations might be based. The same objection will, undoubtedly, be made if the movement for health insurance should suddenly revive. One is tempted, therefore, to look to existing experiments to furnish such data, but even a superficial perusal of the book will clearly indicate what a tremendous task that might be. Probably in the majority of experiments and systems no statistics are kept, and if they are kept they are likely to be inadequate, inaccurate or incomparable with each other. For the reader who will be patient enough to read through this voluminous material carefully, the impression will be inevitable that there is much confusion and little efficiency as a result of leaving the all important problem of health and medical care to the initiative of corporations or even coöperative citizenship groups. One may wonder how far we might have advanced in the matter of a national system of education if that were left to haphazard forces without a definite plan on the part of organized society. From the point of view of demonstration of both quantitative and qualitative inadequacy of voluntary insurance efforts, the work of Mr. Williams and Miss Chamberlain will prove very convincing.

I. M. Rubinow

Credit Policies of the Federal Reserve System, by Charles O. Hardy. Washington: The Brookings Institution. 1932. 374 pp.

In some 350 cogent pages, this book presents a clear-cut examination of the facts relating to federal reserve policy since 1922; and in addition contains a critical though sympathetic analysis of such policy. Combining historical description with analysis in such a manner as to heighten the interest of the book, as well as to strengthen his own conclusions, Mr. Hardy has made a definite contribution to the literature on the subject.

The first part of the book, under the title "Organization and Practice" is devoted to a description of the facts relating to federal reserve policy during the period 1922–31. After considering briefly the fundamental standards of credit policy and the technique of credit control, the author proceeds to outline the various phases of federal reserve policy during this period. Clear visualization of the march of events is enhanced by his use of short descriptive title heads, such as Decentralized credit control, 1922–23; Moderate restraint, April-December 1923; An easy money policy, 1924; A period of neutrality, 1925–26; etc.

The second part of the book, under the title "The Major Standards" of federal reserve policy, takes up in order the stabilization of the money market, the maintenance of sound credit conditions, international coöperation, the reserve board and the stock market, reserve credit and the gold supply, stabilization of prices, and the efficacy of the reserve system's technique. The author maintains that it is not necessarily the function of the federal reserve system to stabilize the cyclical fluctuations in the money market, although it is its proper function to stabilize short-term instability of money rates such as those due to seasonal influences. In fact the essential policies of the federal reserve may conceivably cause wider cyclical fluctuations in the money market; such as the tightening of money rates in a period of prosperity, or the artificial lowering of rates in periods of depression, in order to stabilize other factors in the business situation.

In the author's view, sound credit conditions constitute the best guide to federal reserve policy, and this was primarily the "test of policy" during 1922–23, with good results. His chapter on this subject is an excellent one and the case he presents against the use of the stabilization of business as a test of policy for the federal reserve is a convincing one.

The thesis concerning the part played in federal reserve policy by international coöperation is vibrant with common sense and appreciation of realities. The general conclusions reached are as follows: "The pressure to coöperate has been pressure to pursue an unsound policy, in order to shield other nations from the consequences of their own unsound policies. So long as coöperation is conceived in these terms, the less we have of it the better." It appears to be the view of the book, however, that given the proper technique and adequate recognition of the limited possibilities inherent in international central bank coöperation, some good could come from it.

The story of stock market control and the federal reserve system, while often told, has certainly not been better told than in the two chapters on this subject

in this book. Making free use of the published statements of federal reserve authorities themselves during the course of the period 1922–31, Mr. Hardy presents an enlightening record of the uncertainties in the minds of federal reserve officials as to their duties in respect to stock market speculation. In general, sympathizing with the difficult task which federal reserve authorities had in deciding what their policies should be during the period of the great stock market boom, nevertheless the author concludes that the proper procedure should have been not to attack the stock market, but to bring pressure to bear upon the banks to decrease the volume and the proportion of their security holdings.

He has little sympathy with the view that federal reserve policy should be focussed upon presumptions that there is either a surplus or shortage of gold stocks; and federal reserve policy has little to gain in attempting to use the test of price stability. An interesting six-point criticism of stabilization schemes is presented in the chapter on stabilization of prices.

In general, he considers the reserve system's control of rediscount rates and its open market operations only a crude and circuitous technique for controlling the state of the money markets, and through them the pace of business activity. Nevertheless, the success of the reserve system in dealing with minor disturbances and with seasonal fluctuations and the limited success which has attended its efforts to cope with major difficulties, do justify further effort along this line. Credit control is not a panacea; it is an experiment (p. 239).

Part III takes up the "minor standards" of federal reserve policy, under which are discussed liquidity of commercial bank assets, the federal reserve system and the treasury, and regional uniformity of rates. The issues involved are discussed clearly although very briefly. Part IV is called "The results of credit control." The views expressed in this part are heretic, among them such as the following: "The whole theory of the necessity of self-liquidating quality in bank loans is unsound." "Marketability gives liquidity to secure investments." "Marketability of assets, however, does not assure the liquidity of the banks as a group." But, and this is important in his view—"Commercial loans also are liquid, if at all, only from the standpoint of the individual bank, not from that of the system." There is much here for further discussion, and this last part of the book, if not perhaps the final word on the subject at least should be stimulating (not to say provocative) of further contributions along this line.

JAMES GERALD SMITH

Princeton University

The Real Meaning of Social Insurance, by Hugh H. Wolfenden. Toronto: The Macmillan Company of Canada, Limited. 1932. 227 pp.

If social insurance is to be evaluated it must be described in terms of the complex economic facts and human problems that it is supposed to meet. To write of insurance as a business or mathematical problem may seem scientific. But it is not—if the author fails to analyze the economic, political and human results

of a society in which no individual can be self-sufficient and in which the risk of economic insecurity has become the outstanding human hazard.

This volume covers much ground. It describes provisions in the laws of many countries for health insurance, old age pensions, widows' and orphans' pensions, mothers' allowances, accident insurance and unemployment insurance. Unfortunately the descriptions are brief summaries, not sufficiently analytical or incisive to be truly informative. It is interesting to note how largely Mr. Wolfenden depends on the literature published by either private insurance companies or the National Industrial Conference Board.

Mr. Wolfenden is doubtless a good actuary but he fails to realize that figures, like words, are tokens behind which lie real situations. So he sets down or quotes insurance company heads who have defined what constitute good risks and what basic conditions must be present before the principle of insurance can be successfully applied. Having chosen a safe and exclusive major premise he then proceeds to state that an economic situation such as unemployment does not meet the definition set forth. Therefore he concludes it is not a properly insurable risk. The process seems logical—but it is hollow. The definition accepted as a major premise is not impressive and the situations then described do not bear the ear marks of reality.

The author claims for himself an impartial outlook, but study of the book reveals a set purpose, namely opposition to any extension of government control in the field of insurance. Not only do the definitions offered include the conclusions to be reached, but the facts given show a willingness to avoid unpleasant facts that might ruffle the argument. In discussing wages he describes the upward trend from 1800 to 1926 but fails to refer to the downward tobagganing of wages since 1926, and even quotes with approval in the year 1931 a statement that "the general economic status of wage earners, as well as of other groups of the population, does not justify any assumption of lessened opportunity for individual thrift."

Mr. Wolfenden's point of view is again revealed in his statement of the causes of unemployment. He states that unemployment "may arise from sickness or accident, strikes or lock-outs, misconduct or inefficiency, voluntary absence, dismissal, inability or even disinclination to obtain work, etc." It seems strange to tuck in the inability to obtain work as just *a* cause in the face of the facts of technological and cyclical unemployment as we know them today.

Perhaps the outstanding example of Mr. Wolfenden's method of proving his point is seen in the use of figures in his report on a questionnaire sent out by the Metropolitan Life Insurance Company to 512 employers on the cause of unemployment in 1923. He cites the answers as stating that of 31,336 who ceased work only 3,637 were laid off on account of lack of work and that the remainder had quit voluntarily. Whether strikes occurred or what proportion of these workers were able to improve their status by going to better jobs he fails to tell. But in the next sentence, without even a transitional clause, Mr. Wolfenden states that it is estimated that there are now 7½ to 8 millions unemployed in America, so implying that most of the unemployed of today have voluntarily quit work.

At a time when we need facts scientifically gathered to help us to meet an over-

whelming crisis, Mr. Wolfenden offers us pet prejudices framed in actuarial lingo and illustrated by picked figures.

JUSTINE WISE TULIN

Men, Money and Mergers, by George Hoxie. New York: The Macmillan Company. 1932. vii, 224 pp.

In these times when business is grasping for government aid with one hand—credit, tariffs, the reduction of competition, etc.—and with the other is strenuously resisting all extension of government control over its activity, there is great need for clarification of the principles involved in the relations between Government and Business. Mr. Hoxie's *Men, Money and Mergers* ostensibly attempts such a contribution. Unfortunately his analysis is so superficial, so heavily biased, and smacks so strongly of a defense of the public utility industry as to add little to clear thinking. It only merits extended consideration because it puts its case in terms of the ill-considered assumptions all too familiar in the current literature on the subject.

In approaching the problem, Mr. Hoxie begins by confusing individual liberty of action with the absence of government ownership of business. Thus, he raises the question,

> "Shall the individual have the largest measure of independence consistent with the similar freedom of all of his fellows, or shall populations be massed into coöperative business machines operated by that intangible thing called government —the sole duty of the individual being that of obedience?" Stripped to fundamental essence, all problems of human mass-relationships reduce themselves to the alternatives of harmony dictated from above, or individual liberty of action with all of its jangling discords. (p. vi)

Throughout the volume, he contrasts the assumed glories of individual liberty of action with an assumed condition in which everything is done by the government with individuals as pawns. Yet neither of these contrasting positions appears to be relevant to the problem of the day. On the one hand, individual liberty of action has already ceased to exist in large areas of industry. Today, the larger part of the working population is already "massed into coöperative business machines" (or else idle). What "jangling discords" growing out of individual action are countenanced during working hours among the hundreds of thousands of employees of the American Telephone and Telegraph Company, the Pennsylvania Railroad, the United States Steel Corporation, or the workers on a Ford assembly line? The "harmony of action" in these great enterprises is surely "dictated from above." The individual liberty which, according to Hoxie, would be lost if industry were government operated has to a very important degree been already destroyed by modern business organization and modern industrial technique.

On the other hand, Mr. Hoxie's absolute of government ownership appears to be a scarecrow set up to put the uninitiated to flight. He refuses to admit the possibility that there may be realms of economic activity in which government operation might be more desirable and effective than operation by profit-seeking enterprise. Yet, to be consistent, he must recommend that the schooling of

children be returned to the hands of private institutions where it once lay, that our highways be turned over to profit seeking corporations to be operated as toll ways, and that the fire protection of great cities be left to private, profit seeking brigades. Clearly, neither the type of individual liberty which Mr. Hoxie assumes, nor his hundred per cent government ownership, appears likely to aid in the solution of current problems.

The superficiality of his analysis is further displayed when Mr. Hoxie, allowing that the government might possibly run industry tolerably well if all progress had ceased, denies that the "building of the new" could be accomplished in government-operated business. Wherever examples of more or less successful operation by government appear, as in the case of the Ontario "Hydro" and the Russian activity, he classes them as "skilful copying." Surely, a mind which fails to see that most "creation" is the adapting of old forms to new conditions is not likely to be clear in its appraisal of the capacity or incapacity of government to create.

The same lack of perception appears in Mr. Hoxie's discussion of the dangers of oligarchy in a socialist state—his fear that a socialist group once in control would become a self-perpetuating body. While this would be a real danger in the case of government ownership, it is no new peril, but a condition already existent today in the self-perpetuating boards and managements of many great corporations. His omission of all mention of such corporate oligarchies obscures the fact that the danger against which he warns is as great, if not greater, in the absence of government control than in the presence of such control.

Without taking sides on these vital questions of the relation of Government and Business, one could wish for a more realistic analysis, both from the opponents of government control and from its advocates.

The heavy bias in the book appears whenever the public utility industry is brought into the picture. Thus, the prominent position of the electric power in current discussions of government ownership or control is ascribed to "the newness, the drama, the vital necessity of electricity" (p. 29) with no mention of the possibility that the local-monopoly character of electric power might have anything to do with this widespread interest. It is significant that the book contains no mention of the fact that the author is consulting economist and research engineer for one of the largest operating utility companies in the nation.

The height of Mr. Hoxie's bias appears in the two chapters on "Propaganda for Government Ownership" and "Propaganda against Government Ownership." With protestations of impartiality, Mr. Hoxie fills the first chapter with lurid descriptions of the "frenzied activity of the League for Industrial Democracy," giving long quotations from their annual reports and speeches by prominent socialists. In contrast, he describes the propaganda by public utilities in defensive terms, without offering any of the numerous examples of the type of activity which has aroused such protest. He makes no mention of the fact that utility propaganda has been to an important extent charged to the operating expenses of the utilities and therefore paid for primarily by customers. And, curiously enough, an important part of the chapter on utility propaganda is devoted to further examples of alleged government ownership propaganda.

Throughout the book, Mr. Hoxie's uncritical use of figures and statements

which will support his point of view is evident. A single glaring example will suffice. To combat the idea that the government-owned Ontario "Hydro" is superior to privately owned enterprise, he quotes the thoroughly misleading statement by Mr. Floyd L. Carlisle, Chairman of the Board of the Niagara Hudson Power Corporation, that in a representative year

> the Hydroelectric Commission of Ontario and its associated municipalities sold within the province 3,061,545,371 kwh and received therefor the sum of $32,431,048. The Buffalo, Niagara and Eastern Companies within the Niagara Hudson system, although generating 20 per cent of their energy by steam, that year sold 4,436,403,784 kwh and received therefor the sum of $32,011,782. (p. 93)

Just what is the significance of a comparison between the gross income and total output of one organization selling practically nine-tenths of its output at wholesale and another selling the bulk of its output retail? In the light of the relative proportions of product sold wholesale and retail and the tremendously wide disparity between wholesale and retail rates for electric power in New York State, Mr. Carlisle's figures would seem rather to disprove his statement that "judged by any fair comparison, the companies within the Niagara Hudson system are furnishing electricity to all classes of service cheaper than it is furnished in Ontario." (p. 94) While we might not expect to be free from such misrepresentation by an active head of a great power company with dividends to earn, a utility engineer who does not see the meaninglessness of the gross figures only advertises his own incompetence or lack of good faith.

His further quotation from Mr. Carlisle is equally damaging.

> The entire Niagara Hudson system in 1928 . . . paid in taxes to the various governments as of that year $10,118,867. The entire revenue of the system received in that year from household and farm consumers was $14,937,189. If our companies were relieved of the payment of taxes to put them on the same basis with Ontario they could have sold electricity to their 600,000 household and farm consumers for $4,818,322, which would have been less than one-half of the amount paid by the householders in Ontario. (p. 94)

This deduction of the entire tax bill of a company from the income derived from a very small proportion of the output should be enough to persuade any competent statistician that the book does not warrant his serious attention.

GARDINER C. MEANS

Columbia University

Cause and Control of the Business Cycle, by E. C. Harwood. Boston: Financial Publishing Company. 1932. vii, 165 pp.

The author announces in the Preface that this book not only contains the explanation of the business cycle but that there is also included the factual proof that the explanation given is sound. On the next page he adds that the "scientist is a humble observer."

The boom, he explains, is made possible by an excess of purchasing power with respect to current production. The banks lend more than the accumulated savings at the disposal of the banks justify. The excess of such credit extension over accumulated savings is the measure of the excess of purchasing power put into circulation (p. 35).

This sounds a bit like Keynes or *Hayek, but one is quickly disillusioned.* What is compared is not investment and saving, as these terms are used by either Keynes or Hayek, but the "investment-type assets" of banks and savings deposits. If the investment-type assets outrun savings deposits, you have inflation; if they *fall below, you have deflation. The argument is that if these two* were kept in line, the business cycle would be eliminated.

This conclusion is, of course, entirely mistaken. Suppose savers made all their investments directly rather than through the instrumentality of banks, and suppose *all banks limited themselves exclusively to commercial loans, then no mal*adjustment would be possible according to the analysis given in this book. In point of fact, however, such banks by expanding or contracting commercial loans might cause violent fluctuations in the volume of circulating media. Any expan*sion of the means of payment* would cause investment to outrun saving in Hayek's sense, and so, in his view, cause instability. This is not the place to discuss Hayek's thesis, but it is at any rate clear that the ratio of "investment-type assets" and "savings" may exactly balance, and yet investment and saving, properly defined, may be thrown quite out of equilibrium by the banks.

All of Mr. Harwood's statistics, therefore, are of no assistance in analyzing the problem of monetary instability. It is, of course, to be expected that the ratio of investment-type assets to savings will rise in the boom and decline in the depression if for no other reason than that in the former period time deposits tend to be transferred to demand deposits, and in the latter period the reverse is the case. Moreover, it is admittedly true that deposits are likely to originate in the boom period out of loans based on securities.[1] But the relationship here pointed out is not a necessary one. At all events it is the expansion of loans which is significant and not whether such loans are commercial or "investment-type" loans. Mr. Harwood appears to hold the wholly fallacious view that commercial loans are necessarily always balanced by an equivalent physical volume of goods coming on the market.

Everything considered, the book makes no theoretical contribution, and the statistical index presented is at best one of an almost endless number of series which *reflect* the course of the cycle, but can serve neither to explain nor to forecast the cycle, except in the very general sense that a rising movement (of a series which fluctuates cyclically) is likely sooner or later to be followed by a falling movement.

Alvin H. Hansen

University of Minnesota

Financial Policies of Public Utility Holding Companies, by Merwin H. Waterman. University of Michigan Business Studies, Vol. V, No. 1. 1932. 186 pp.

This is a study of five holding company organizations. It is concerned primarily with management as reflected in financial and operation policies, and consequent returns to the owners, rather than with social or public implications of the holding company systems.

[1] Moreover, a trend movement in the ratio of investment-type assets to savings is evident, apparently due to structural changes in financing methods.

The companies included are the American Power & Light Company, the Associated Gas & Electric Company, the North American Company, the Standard Gas & Electric Company, and the United Light & Power Company. Each, with its intermediary holding and affiliated companies, and its subsidiary operating companies, constitutes a large system of different kinds of utilities widely dispersed over different parts of the country. The smallest has stated book assets of about $500,000,000, and the largest $1,000,000,000.

The study starts with the properties and financial status for three companies as of December 31, 1924, and for two as of December 31, 1925; it presents the developments in a period of five and four years respectively; and it finishes with the property and financial status as of December 31, 1929. It is concerned especially with the financial policies employed by the different systems, including the relative proportions of parent company and subsidiary company financing, the extent of relative equities acquired by the parent companies, the methods of effecting acquisitions of subsidiary properties, and the types of securities issued. The author presents an initial statement which summarizes his conclusions with respect to the various operating and financial policies. These may be further condensed as follows.

The industrial and geographical diversification of properties under the control of a single holding company adds little to the effectiveness and profitableness of operation. The advantages of size are realized primarily within concentrated areas, not in wide dispersal of different classes of small properties. Parent company financing has not proved satisfactory, and under the financial stress since 1929, the operating companies have furnished practically the sole source of financing. A simple financial structure is essential; complicated issues have proved bewildering to investors and a source of weakness to the system. The author does not approve of convertible bond issues, and is not favorably impressed with customer-ownership as a source of new capital.

With these conclusions, the reviewer is in full record. The study as a whole is a good job. In the five chapters which deal in detail with the financial policies of the five systems, the author is perhaps led to over-analysis and repetition of rather unimportant matters. At the same time, with his preoccupation with managerial effectiveness, he has overlooked certain basic considerations which not only involve the direct business aspects, but certainly affect the public functions for which the utilities are responsible.

There is the purchase price of newly acquired subsidiaries. A large part of the so-called new financing during the four or five year period rather obviously represented securities issued in the acquisition of additional subsidiaries, and not new capital for construction by companies already controlled. In all such acquisition, the basic consideration, both from the standpoint of business efficacy and public interest, was the reasonableness of the price paid. During the period, the stated book assets of the five systems increased over 2.5 times. Presumably the bulk of this increase consists of subsidiaries purchased. The price was fixed under competitive bidding by different groups, with little regard to the actual or replacement cost of the properties or their "fair value" for rate making. The author gave no consideration to the reasonableness of the payments, and ignored

the over-valuations or over-capitalization effected through the acquisition of subsidiaries. This is certainly a matter of business effectiveness as well as public significance.

The author discusses at length the relative parent company financing. He shows especially that the Associated Gas & Electric Company resorted much more extensively to parent company financing. This, however, may be more nominal than real. It may represent largely excessive prices paid for properties, which were then imbedded in the asset account through capital "write-ups." The reviewer has in mind one such subsidiary whose properties were written up at least $25,000,000. This resulted nominally in a showing of parent company financing, but actually involved no new capital at all.

While the study throughout places emphasis upon financial stability it disregards entirely the rate policies and their bearing upon the financial status of the systems. There are striking contrasts between the five companies. The North American Company has been one of the leaders in reducing rates with technological developments and the reduction in costs of production and distribution. In contrast, the Associated Gas & Electric system has maintained notoriously high rates for residential, commercial and municipal consumption. A group which has resisted the country-wide demand for sweeping rate reductions faces greater financial pressure than one which has given more reasonable consideration to the public interest. The business effectiveness of management can hardly be segregated from the public implications involved in the management policies.

The author gives his approval to substantial bond financing, and practically to indefinite continuance of the indebtedness. The view that bond amortization, or retirement, is not needed ignores the experience of recent years with sharp decline in price level as well as the longer experience with industrial obsolescence.

Utility as well as other industrial history amply demonstrates the wisdom of not only limiting bonded indebtedness according to conservative standards, but also providing for definite amortization and retirement over a reasonable period of years. The proper time to provide for payment is when the debt appears entirely safe and when amortization apparently is not needed. To wait until the industry begins to slide or till price level has fallen, is to bring losses upon the bondholders. Even as to management, the present fixed charges of some of the properties included in the study doubtless stand in the way of adjustments which ought to be made in the interest of long-run efficiency.

Finally, there is a basic consideration which cannot be disregarded in a far-reaching study of public utility ownership and operation. In his introductory comments, the author observes that "one would think that if the public utility holding companies were properly financed and soundly managed *from a long-run profit standpoint* (italics ours) they would be free of some of the evils which are alleged to be inherent in this form of organization." But here is the rub. In a utility there is an underlying and continuous conflict between private profit and public interest. The returns are intended to be limited through public regulation. Consequently, the profits to the management, especially one with a thin equity, come more from financial manipulations than from solid long-run development, increasing operating efficiency and permanently sound financial policies. There

is a grave question whether indeed private organization can be preserved either for effective long-run business objectives, or for carrying out policies in the interest of the public at large. The two purposes certainly must be considered together. The one cannot be adequately treated without regard to the other.

JOHN BAUER

Facing the Facts: An Economic Diagnosis, edited by J. G. Smith. New York: G. P. Putnam's Sons. 1932. 352 pp.

This book was written by twelve professors of economics of Princeton University. Each professor has written on the subject in which he is somewhat a specialist; the problems discussed are some of the outstanding current national economic problems. The introduction was written by Professor Frank A. Fetter.

The chapters of the book and the authors of each are as follows: 1. The Gold Standard in the United States, by Edwin Walter Kemmerer. 2. Budgets, Bonds and Ballots, by Harley L. Lutz. 3. Tariff Policy and Foreign Trade, by Frank Whitson Fetter. 4. Reparations, War Debts, and Foreign Investments, by Charles R. Whittlesey. 5. Business, Incorporated, by Stanley Edwin Howard. 6. Banking and the Stock Market, by James Gerald Smith. 7. Big Business and the Nation, by Frank Albert Fetter. 8. Regulating the Power and Light Industry, by Leslie Thomas Fournier. 9. The Railroad and Its Competitors, by Frank Haigh Dixon. 10. Liquor Control and Prohibition, by James Douglas Brown. 11. Whither Agriculture? by Archibald MacDonald McIsaac. 12. Unemployment, by David A. McCabe.

These various subjects are fairly well correlated so that the book has more unity than a great number of joint productions. However, it lacks the kind of central unity which would be given by a single author. On the whole, the discussion of each of the twelve problems is profound and enlightening. There are few panaceas advocated by the different authors in dealing with these problems. There appears to be an attempt to get at the principles underlying the problems with the view of giving a basis for handling them intelligently.

To try to estimate the value of each of the chapters by the different authors would make this review entirely too long. However, I shall make a few remarks in reference to some of them.

Professor Kemmerer's chapter on The Gold Standard in the United States is a fairly good discussion of our monetary and banking problems since the World War. However, there is little said about the gold standard in the United States, and one seeking detailed knowledge of the operation of the gold standard would be disappointed in reading this chapter.

Professor Lutz's discussion of Budgets, Bonds and Ballots is a very penetrating discussion of the problems of raising public revenues and the problem of controlling expenditures. He points out the glaring weaknesses in our present Federal budget policy.

Professor Whittlesey's discussion of Reparations, War Debts, and Foreign Investments is a good one. He indicates that it is necessary for America to formulate a definite policy toward the export of capital in the future.

The chapter on Big Business and the Nation, by Frank Albert Fetter, is, in my opinion, the best chapter in the book. He makes clear the necessity of the formulation of a new social control policy in this field.

The book is a valuable contribution to the discussion of our numerous national economic problems of today. We are in a period of reconstruction and we need all the light which can be given on these problems.

Arthur B. Adams

University of Oklahoma

Business Statistics, by Joseph Lyons Snider. (Second Edition.) New York: McGraw-Hill Book Company, Inc. 1932. xi, 498 pp.

This is a collection of cases and materials designed to assist the mature student of business in the practical applications of statistics to business problems. While the book assumes considerable knowledge of economics and statistical methods, much of value can be obtained by those who do not have a technical background. Distinct progress is noted in the book as compared with its first edition. The material has been reorganized, new material added, and old material brought up to date.

The book treats largely of external statistics. Relatively little is included on strictly internal statistics or on the problems of internal statistical control. The author approaches the problem of organizing his material by grouping the external developments which affect individual businesses under three main headings: (1) developments in commodity markets, in particular, changes in the prices of individual commodities; (2) developments in the industry with which each business is most closely identified; and (3) general business developments. Although developments in these groups are largely beyond the control of the individual, the more the individual understands conditions in these fields, the better he should be able to regulate his business. The cases and materials are, consequently, grouped under four major parts as follows:

Part I, dealing with the statistical position of the commodity, presents material designed to provide an introductory training in forecasting the price of an individual commodity. The material illustrates the various procedures followed in actual practice.

Part II brings together material applying to several leading industries selected for illustration, and is designed to acquaint the student with the types of industry statistics currently available, with the fluctuations of these industries during recent years, and with useful procedures in estimating future prospects.

Part III relates to the more important measures of general business conditions. These measures apply to the total volume of business and to its various segments, such as industrial production and retail trade, and also to the general commodity price level, money markets, the banking system and the security market.

Part IV, concerned with general business forecasting, shows the methods of several of the leading forecasting organizations and serves to illustrate different approaches to the problem.

Supplementary material including important statistical series, brief descrip-

tions of statistical methods, and a short description of sources of data, are added in the appendices.

This type of book as a class text or manual is purposely designed to leave much to the lecturer or group discussion. It is the reviewer's opinion that it is preferable to direct the reader's attention in some manner to advantages, dangers or weaknesses in a method or procedure in case they might not be recognized by the reader or brought to light by the lecturer or group discussion. This objective has been attained to some extent by including a set of carefully designed questions at the end of a case. The reviewer believes that a further use of this plan would have been desirable. For instance at the end of the construction section (pp. 97 to 121) questions might have called attention to the qualifications of building permits and contracts awarded as a basis of a construction index. And they might have called attention to the danger of assuming, on the basis of a short period, that a definite relation exists between construction activity and interest rates, or that such an apparent relation may be expected to exist in the future when both series are affected by so many different outside factors. When one keeps in mind, however, the use for which this book was intended, it is not believed that an alert and qualified student would actually be misled in his studies of the materials as now presented.

On the whole the book is a well selected and carefully edited collection of cases and materials, and it represents a worthy contribution to the available literature on the practical application of statistics in business.

JOHN R. RIGGLEMAN

Statistical Yearbook of the League of Nations. Geneva. Obtainable in the United States only from World Peace Foundation, 40 Mt. Vernon Street, Boston. viii, 342 pp.

Among Americans interested in numerical facts, the *Statistical Abstract of the United States* has long been known as "the statistician's bible." In the future, students of world problems will doubtless be inclined to give to *The Statistical Yearbook of the League of Nations* some equally impressive title, for it likewise comprises a wealth of information.

We are informed by A. Loveday, Director of the Financial Section and Economic Intelligence Service of the League of Nations that "an attempt has been made to cover as many countries as possible and to render the statistical series comparable over the whole of a given period." This program is, of course, very ambitious but difficult of execution. In an effort to minimize errors, official sources have been used in so far as possible. In other cases, care has been taken to check the validity of the figures, whenever such a course was feasible. Footnotes differentiate admittedly rough estimates from data supposedly more reliable. When obtainable, figures have been presented for each of the last ten years.

Titles are given throughout both in French and English, and there is a complete index in each of these two languages. Maps of the various continents show the boundaries of the different nations covered by the statistics. A novel feature of the book is a series of parity ratios which make it relatively easy to

convert amounts in one currency to amounts in any other currency. Other tables show the metric equivalents of important national measures of length, area, capacity, and weight.

The tables cover, for each nation, a great variety of topics among which may be mentioned area, population classified by age, sex, and occupation, illiteracy, births, deaths, marriages, migration, employment and unemployment, strikes, numbers of various classes of livestock, number of animals slaughtered, production of various minerals, agricultural products, and manufactured goods, imports and exports, the balance of international payments, tonnage of shipping, railway mileage and traffic, number of automobiles, public finance, public debt, money in circulation, gold stocks, bank deposits, stock prices, bond yields, exchange rates, wholesale prices, retail prices, and wage rates.

While some may doubt the success of the League of Nations from the standpoint of maintenance of international peace, presumably every statistician will applaud the achievement of the Financial and Economic Section of the League in turning out this comprehensive and well systematized Yearbook.

WILLFORD I. KING

New York University

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JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

THE EFFECT OF THE DEPRESSION UPON BOND YIELDS[1]

By Carl Thomas

As an introduction to a technical analysis which will enable us to measure the effect of the depression upon bond yields, let us consider a well-known economic problem, namely, the possibility of stimulating a general bond market through action upon the short-term interest rate. As a background for this problem, let us recall Mr. Keynes' thought in this connection. He holds, if I interpret him correctly, that a reduction in the short-term interest rate would lead to a reduction in bond yields or a rise in bond prices, and consequently a rise in the value of capital goods. This would stimulate investment which would lead to the production of investment goods, which, in turn, would be accompanied by *a general increase in industrial activity*.[2] *Without accepting* this train of thought as a valid or useful general description of the genesis of industrial fluctuations, let us consider the initiating forces.

The technical problem, accordingly, is to determine (1) the extent to which changes in the short-term interest rate affect bond yields, and (2) the nature of other economic factors which may modify this effect. The first step to be taken in its solution is to identify and measure quantitatively the major elements of bond yields.

The Standard Statistics Company's Index of Yields upon 60 High

[1] This paper is a revision of an earlier presentation given at the Ninety-fourth Annual Meeting of the American Statistical Association on Friday, December 30, 1932.

[2] The following is a close paraphrase of a portion of page 154, John Maynard Keynes, *A Treatise on Money*, Vol. I, Harcourt, Brace and Company, New York, 1930.

> . . . The lower the rate of interest, the higher, other things being equal, will be the value of capital goods. If the rate of interest falls, the price level of capital goods will tend to rise, which will *raise the rate of profit in the production of capital goods*, which will stimulate new investment. Thus, a low rate of interest will tend to increase both the price level and volume of output of capital goods.
>
> The rate of saving, on the other hand, is discouraged by a low rate of interest.
>
> It follows that a decline in the rate of interest tends to make the rate of investment greater than the rate of saving, so that price levels, in general, tend to rise. Rising prices are accompanied by increased industrial activity. . . .

Grade Bonds,[1] hereinafter referred to as simply "Bond Yields," may be resolved analytically into the five following elements.

1. *Money Market Effect.*—This element is directly related to fluctuations in the commercial paper rate (in the New York Market) hereinafter referred to as the "Short-term Interest Rate." It appears reasonable that fluctuations in the "Short-term Interest Rate" should be reflected in "Bond Yields" in view of the fact that these fluctuations are probably proportional to changes in the general supply and demand situation in the central money market; and because the bond and commercial paper markets are integral parts of the central market—the general exchange center for cash balances and long- or short-term maturities.

2. *Secular Factor.*—This element probably represents slow changes in (a) the general level of prices, (b) the ability of the community to purchase bonds, (c) the rate at which industry and governments require bond financing, and (d) relative profitableness of bonded enterprise.

3. *Inverse Effect of Fluctuations in "Trade Volume."*—The third element of "Bond Yields" appears to be related inversely to fluctuations in a well-known physical index of industrial production, hereinafter referred to as simply "Trade Volume." It seems reasonable that fluctuations in "Trade Volume" should be inversely related to "Bond Yields," since fluctuations in industrial production contribute in a major way to fluctuations in industrial net profits, and since fluctuations in net profits are accompanied, in general, by fluctuations in the margin of safety of fixed charges. The relation which exists between this "Normal Risk" element of "Bond Yields" and industrial net profits is shown on Chart III.

4. *Direct Effect of Fluctuations in "Trade Volume."*—This element appears to be directly related to sporadic departures of "Trade Volume" from the general line of development of major movements. It is reasonable that this element should be revealed in an analysis of "Bond Yields," for it is common experience that the immediate and exceptional opportunity for profitable employment of cash balances influences bondholders to exchange cash balances for bonds (or the reverse).

5. *Residual Irregularities.*—But one significant irregularity remains after the four preceding elements have been considered. This appears to record the effect upon "Bond Yields" of the financial crisis of the past year.

These five elements, whose sum is equal to "Bond Yields," are shown

[1] This Index (Chart I) includes 15 industrial, 15 railroad, 15 public utility, and 15 municipal bonds all of which mature in 25 or more years.

CHART I

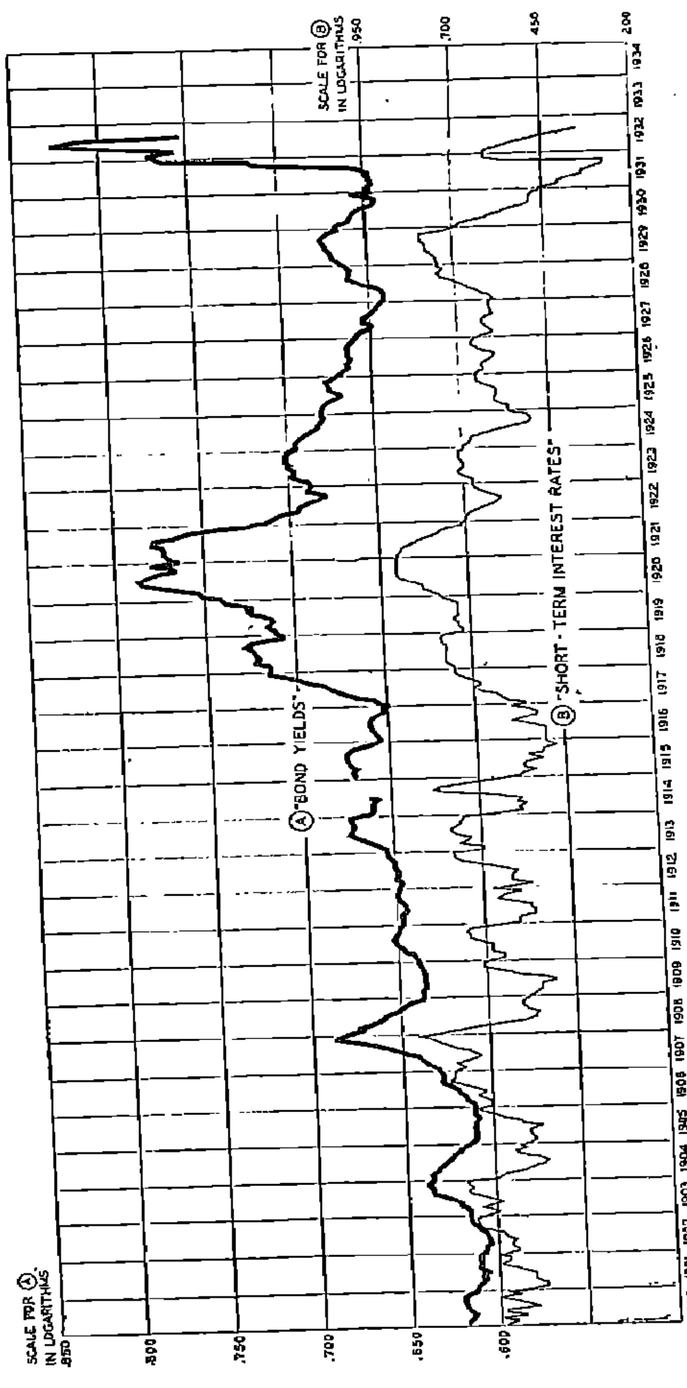
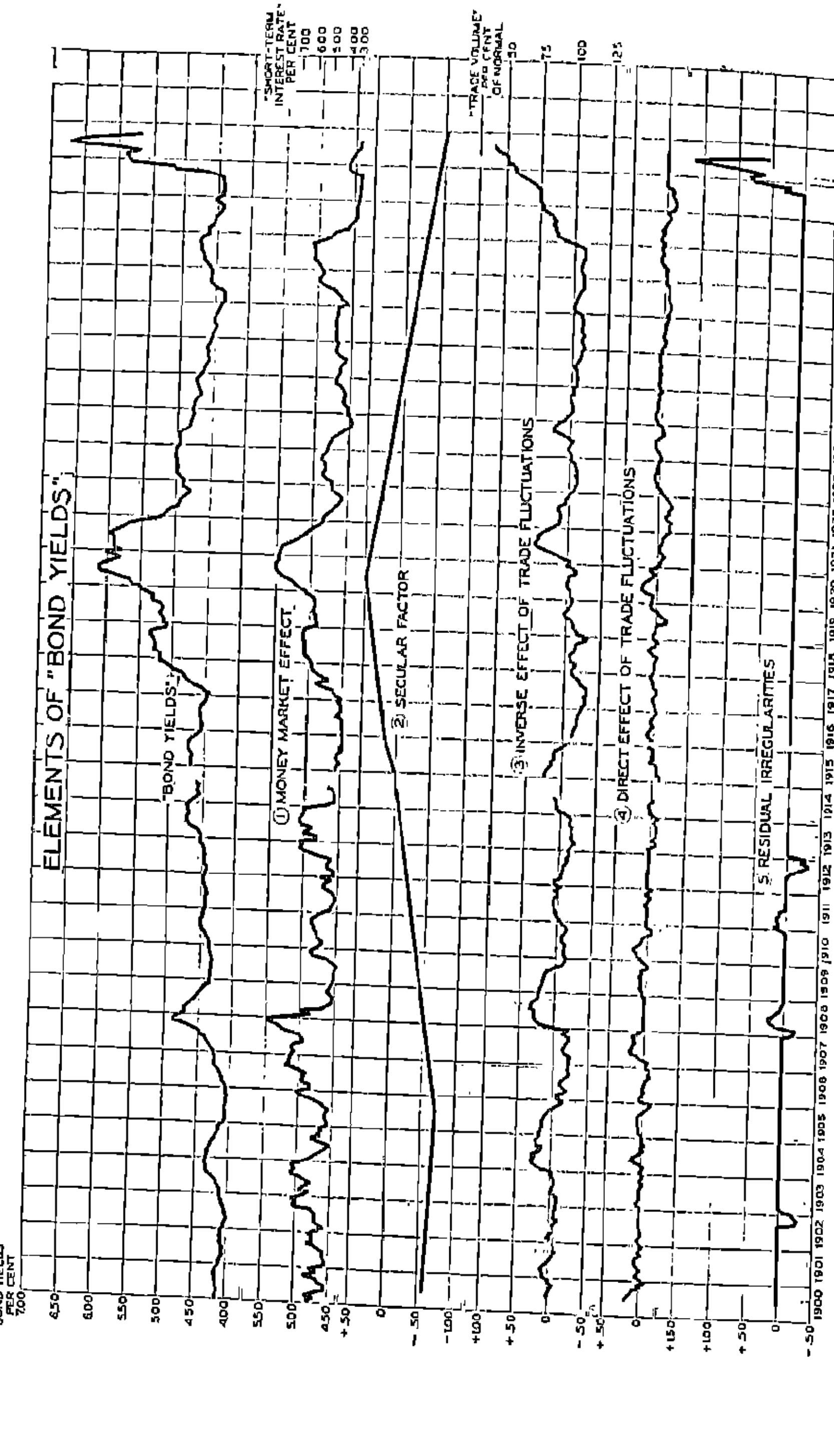

SCALE FOR (A) IN LOGARITHMS
.850
.800
.750
.700
.650
.600
SCALE FOR (B) IN LOGARITHMS
.950
.700
.450
.200
(A) "BOND YIELDS"
(B) "SHORT-TERM INTEREST RATES"
1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934

CHART II


ELEMENTS OF "BOND YIELDS"
"BOND YIELDS"
① MONEY MARKET EFFECT
② SECULAR FACTOR
③ INVERSE EFFECT OF TRADE FLUCTUATIONS
④ DIRECT EFFECT OF TRADE FLUCTUATIONS
⑤ RESIDUAL IRREGULARITIES
"BOND YIELDS" PER CENT
"SHORT-TERM INTEREST RATE" PER CENT
"TRADE VOLUME" PER CENT OF NORMAL

on Chart I. Upon this Chart fluctuations of the various elements and those of "Bond Yields" are strictly comparable, since all have been expressed in the same ("Bond Yields") units.

Chart II shows in detail the progressive resolution of "Bond Yields." The detail of the relation which appears to exist between the remainder of "Bond Yields" (after elements (1) and (2) have been removed) and fluctuations of "Trade Volume," is particularly interesting. Here the simultaneous positive and negative relation between "Bond Yields" and "Trade Volume" is clearly indicated—as are the residual irregularities, more particularly the effect of the recent financial crisis.

Normally—that is, excepting (4) sporadic movements of "Trade Volume," and (5) residual irregularities—"Bond Yields" appear to be affected in a calculable way by three major factors, namely: (1) fluctuations in the "Short-term Interest Rate," (2) a secular factor, (4) fluctuations in "Trade Volume."

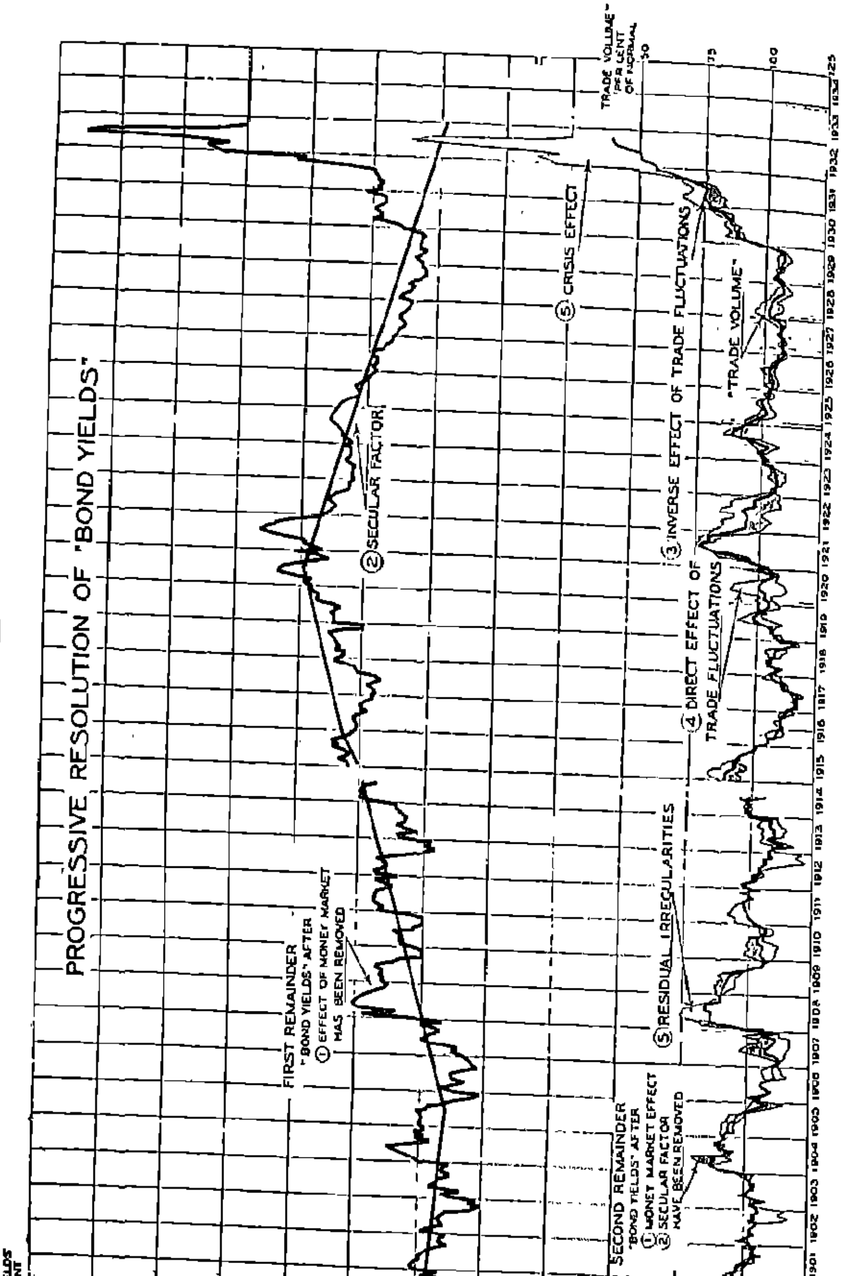
From a knowledge of the normal relations which exist between each of these three factors and "Bond Yields," it is possible to calculate their several effects upon "Bond Yields" in the past. Furthermore, by assuming particular future values of the same factors, together with continued normal relations, it is also possible to calculate future "Bond Yields" with an average historical error of approximately .05 per cent in yields.

To facilitate such calculations, nomographs embodying these normal relations have been prepared (Chart IV) and an example of their use provided at the end of this article.

In the past, the effects upon "Bond Yields" of (1) fluctuations in the "Short-term Interest Rate" (money market effect) and (4) fluctuations of "Trade Volume," appear to have been of roughly equal importance. Each contributed as much as .60 per cent to "Bond Yields" in periods of maximum fluctuation, for example, during the years 1902–09, when "Bond Yields" varied between 4.00 and 4.80 per cent. During war years, however, war and Government activities pressed upon the money market to a much greater degree than "Trade Volume" responded to war orders. The effect of the money market upon "Bond Yields" was, accordingly, relatively greater than that of "Trade Volume." During these years, the effect of the money market probably exceeded .05 per cent.

The depression from 1929 levels involved an unprecedented negative fluctuation of "Trade Volume" and a major decline in the "Short-term Interest Rate." The former contributed an increase in "Bond Yields" of approximately 1.50 per cent and the latter a decrease of roughly .75

CHART III


PROGRESSIVE RESOLUTION OF "BOND YIELDS"
"BOND YIELDS" PER CENT
FIRST REMAINDER
"BOND YIELDS" AFTER
① EFFECT OF MONEY MARKET
HAS BEEN REMOVED
② SECULAR FACTOR
⑤ CRISIS EFFECT
SECOND REMAINDER
"BOND YIELDS" AFTER
① MONEY MARKET EFFECT
② SECULAR FACTOR
HAVE BEEN REMOVED
⑤ RESIDUAL IRREGULARITIES
④ DIRECT EFFECT OF
TRADE FLUCTUATIONS
③ INVERSE EFFECT OF TRADE FLUCTUATIONS
"TRADE VOLUME"
TRADE VOLUME PER CENT OF NORMAL
+250
+200
+150
+100
+50
0
-50
-100
-150
-100
+50
0
-50
50
75
100
125
1900
1901
1902
1903
1904
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1933
1934

per cent. Beginning in September, 1931, the financial crisis appeared and, in May of 1932, contributed a further increase of approximately 1.70 per cent. At the present time, however, the crisis effect has declined markedly and now amounts roughly to .60 per cent. The net effect of these three factors was an increase in "Bond Yields" of approximately 1.35 per cent. This is a fair estimate of the net effect of the depression upon "Bond Yields." It may be observed that the decline in "Trade Volume" (roughly twice as great as any previously recorded) contributes the major portion of the depression effect.

The nomographs of Chart IV, which condense the quantitative findings of the previous statistical analysis, provide the material necessary for the solution of our immediate problem which, it will be recalled, concerns the effect of changes in the "Short-term Interest Rate" upon "Bond Yields" as a means of stimulating the market for high grade bonds.

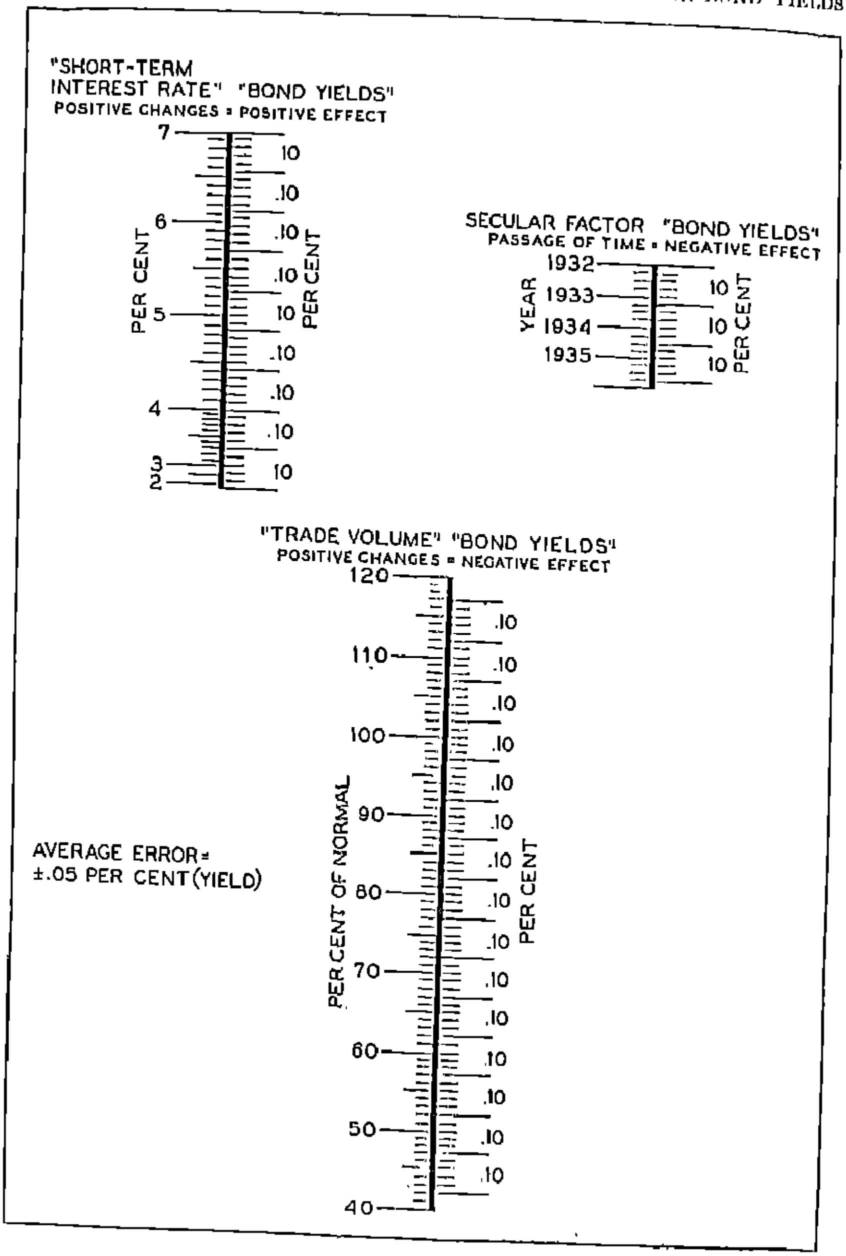
It may first be noted that the effect of changes in the "Short-term Interest Rate," when the latter lies between 2 and 3 per cent, is much less than when it lies between 5 and 6. Changes at or near a 75 year average rate of 4.95 per cent would, therefore, be more effective than the same changes at a lower level. It may also be noted that the inverse effect of "Trade Volume" upon "Bond Yields" is proportional throughout the entire range of the data. These observations lead to a separate consideration of two major aspects of our problem: first, when "Trade Volume" and the "Short-term Interest Rate" are both at or near their respective "normals," and second, when both are subnormal, as at present.

The first is the traditional "normal" situation, properly the starting point of theoretical discussions such as that of Mr. Keynes. In this case, other factors aside, it is clear from the nomographs that a decrease of 1 per cent in the "Short-term Interest Rate" would result in a decline of approximately .24 per cent in "Bond Yields." The high grade bond market would thus, normally, be stimulated to this extent, providing "Trade Volume" and the secular factor remained unchanged. It may be observed, however, that historically, both of these conditions are improbable. For our immediate purpose, therefore, it is desirable to note that it would require a decline in "Trade Volume" (industrial activity) of only 12 per cent to offset a 1 per cent decline in the "Short-term Interest Rate" and consequently to neutralize its effect as a stimulant. Thus, even at or near "normal" economic conditions, the net effect of lower interest rates in the central money market would depend largely upon current movements of

CHART IV

NOMOGRAPHS

SHOWING EFFECTS OF CHANGES IN THREE MAJOR FACTORS UPON BOND YIELDS



An Example of the Use of the Nomographs Shown on Chart IV

Assume:

(a) "Bond Yields" as of October, 1932. . . . . 5.25 per cent
(b) Return of the "Short-term Interest Rate" to 4.05 (75 year average). . . . . January, 1935
(c) Continuation of present secular decline in "Bond Yields". . . January, 1935
(d) Return of "Trade Volume" to 100. . . . . January, 1935
(e) Complete disappearance of the financial crisis.

To Find:

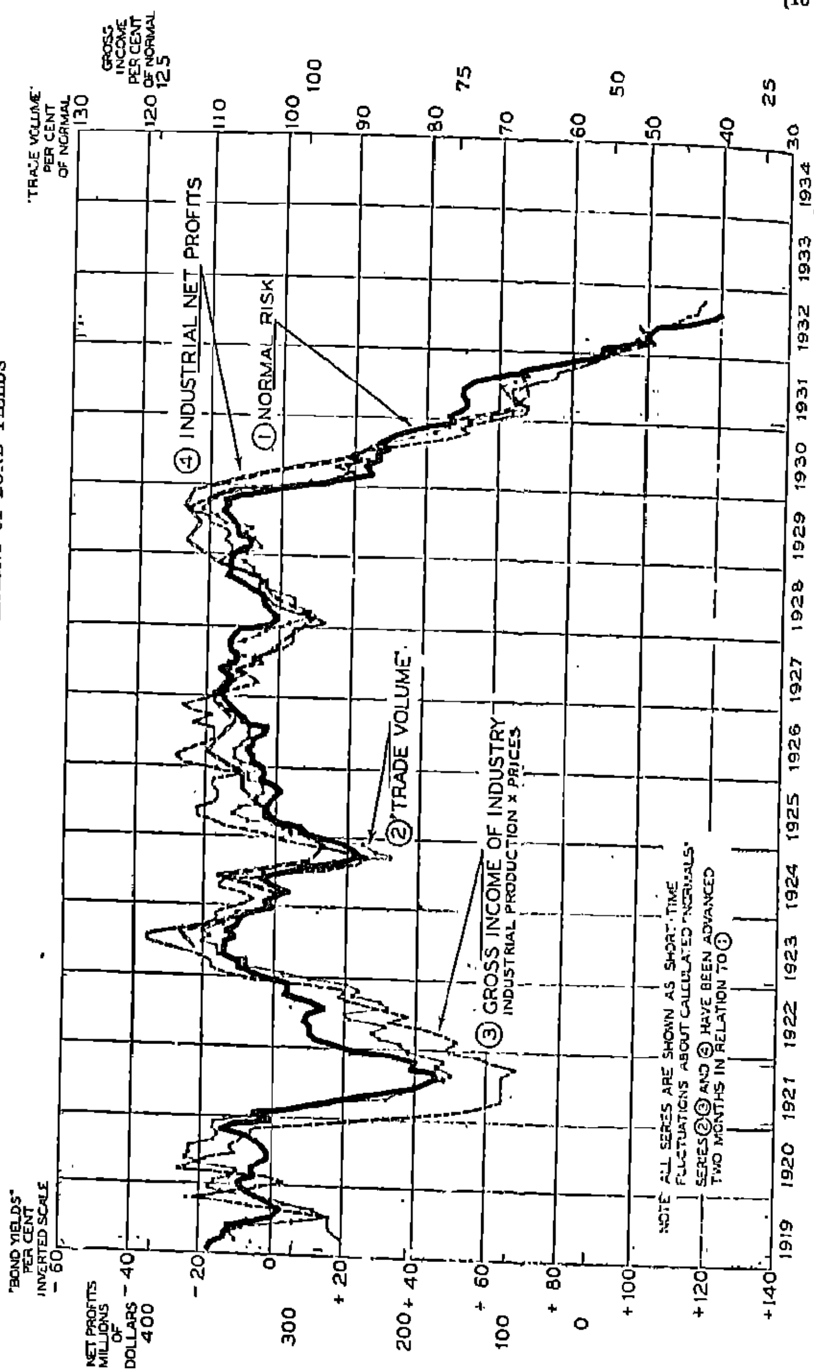
(a) "Bond Yields" as of January, 1935.

The Calculation:

Change in	*From*	*To*		*Effect Upon "Bond Yields"*	
(b) "Short-term Interest Rate".	2.00	4.05	Read, on nomographs, the effect upon "Bond Yields" of given changes in factors b, c, d	+ .40	per cent
(c) Passage of time.	October, 1932	January, 1935		− .25	
(d) "Trade Volume". . . .	−40	100		−1.20	
(e) Passing of the financial crisis.				− .60	
			Net Change	−1.65	. . . . (1)
Average error (historical).				± .05	
			"Bond Yields" as of October, 1932	5.25	. . . . (2)
(2) − (1)			"Bond Yields" as of January, 1935	3.60	±.05

CHART V

SIGNIFICANCE OF THE NORMAL RISK ELEMENT OF BOND YIELDS



"Trade Volume." In other words, the element of "Bond Yields," which appears to be inversely proportional to changes in "Trade Volume," could be expected at all times to augment or offset effects of changes in the "Short-term Interest Rate." Mr. Keynes' argument, therefore, is incomplete. For its completion, it is necessary to consider, in addition, the effect of the fluctuations in "Trade Volume" upon "Bond Yields"—even when the argument is applied to the "normal" situation.

The second case is where both "Trade Volume" and the "Short-term Interest Rate" are depressed, as at present. This is virtually a test case for the theory of stimulation of the bond market through changes in the "Short-term Interest Rate," for it is during depression periods that such procedure would be of the greatest practical value.

Referring once more to the nomographs of Chart IV, it is clear that with the "Short-term Interest Rate" at or near 3 per cent, a further decline of 1 per cent would have practically no effect upon "Bond Yields."

It would, accordingly, prove disappointing to look for stimulation of the bond market from this source alone, when, as at the present time, the "Short-term Interest Rate" is even lower. On the other hand, the present level of "Bond Yields," being affected proportionally by the extraordinary decline of "Trade Volume," is high, because of this factor alone, to the extent of approximately 1.20 per cent, an impressive figure.

Thus, during a major depression, it is clear that the level of "Bond Yields" depends, in the main, upon the course of "Trade Volume." Because of this, it appears that the effectiveness of changes in the "Short-term Interest Rate" would be negligible, in terms of Mr. Keynes' theory, at precisely the time when they could be of the greatest service.

From the foregoing analysis, it appears that, from a practical standpoint, the popular theory of stimulating the bond market by depressing the "Short-term Interest Rate" requires modification to the extent that the effect of fluctuations in "Trade Volume" upon "Bond Yields" needs to be considered. It is necessary at present, above all times, to consider this effect.

At the present time, the high levels of "Bond Yields" appear in the main to be the result of the current trade depression, and to be practically independent of the current supply and demand situation in the central money market.

It follows that the course of "Bond Yields" in the immediate future will depend largely upon the future course of "Trade Volume."

A DISCUSSION OF THE ACCURACY OF AGRICULTURAL CENSUS ENUMERATION IN THE NORTHEAST

By I. G. Davis, *Connecticut State College*

The reports of the United States Census of 1930, particularly as they apply to townships and other minor civil divisions, and in respect also to certain important state and county totals, have been regarded as unreliable in a number of important areas in the United States. On the other hand, in many important agricultural regions the 1930 Census is regarded as satisfactory. Reports received from departments of agricultural economics in the several land grant colleges would indicate that there is a belief that serious inaccuracies exist in all areas affected with part-time farming, and in other important areas where special conditions prevail. Such areas would include the frontier areas, the semi-arid regions, the cropper-tenant sections of the Cotton Belt, self-sufficing areas, and a considerable number of other areas where the methods of the Census failed to prove sufficiently adaptable to conditions to yield dependable results.

The purposes of this paper are to examine the reliability of Census results under one set of special conditions where the Census is deemed to have gone astray, namely, in part-time farming areas, and to discuss certain proposals for improving Census methods in these areas. Much of the paper will be devoted to a specific area, the Eastern Connecticut Highland, and certain very general conclusions will be projected from the facts of this particular area.

Grounds for suspicion as to the accuracy of the Census in Connecticut arise from a number of sources. The 1930 Census reports a decrease of about twenty-six per cent in the number of farms in the state. Since the definition of a farm used by the Census in form, at least, remained unchanged, and since the number of places falling within the scope of this definition is generally regarded as not having actually declined, the Census result reporting such a falling off immediately raises a question of accuracy. This fact as to the amount of change naturally leads one who is interested in the question of the localization of change and the direction of local or township trends to ask the question: "Where did these changes occur? Were they characteristic of certain areas, soil types or locations with relation to the centers of population?" The answer is negative. Adjoining townships throughout the state existing under conditions of marked likeness as to soil, topography, relation to population centers and economic institutions

exhibit extremely marked variations in the direction of change, as shown by the Census, from 1920 to 1930. Chart I shows the per cent change in the number of farms in Eastern Connecticut by townships. No further comment is necessary than to ask the reader to study the map carefully and observe the numerous cases where these marked variations occur.

Means were sought to find some generalized expression of the extent of these variations. For any two towns it was assumed that the algebraic difference in the per cent of change occurring over a given interval of time would constitute a good measure of the variation in change. For example, if in town A the number of farms had increased 25 per cent and if in town B, adjoining, the number had decreased 25 per cent, the algebraic difference would be 50. These differences would constitute a rough index of difference in the rates of change between towns. There are a number of cases where the difference in rates of change between adjoining towns exceeds 100 and a larger number of cases where it exceeds 50. It is not logical to expect the existence of these marked discrepancies in the direction of trends in adjoining towns where conditions are fairly similar, and it is entirely contrary to the experience and observation of those who live in the territory and are familiar with events of the past seven years. It would seem, therefore, that these discrepancies must have been the result of some inconsistencies in enumeration.

It was decided to formulate a method of summarizing the degrees of difference appearing between adjoining towns.

The method employed was to compare the percentage change in each town with the weighted average percentage change in all adjoining towns within a given area deemed to be fairly homogeneous with respect to the operation of forces causing change. For example, suppose in township C the number of farms had increased 25 per cent and the weighted average percentage change in all adjoining towns was a 25 per cent decrease. The figure used would again be +50 for the given town. Frequency distributions were constructed and standard deviations computed for the series thus derived.

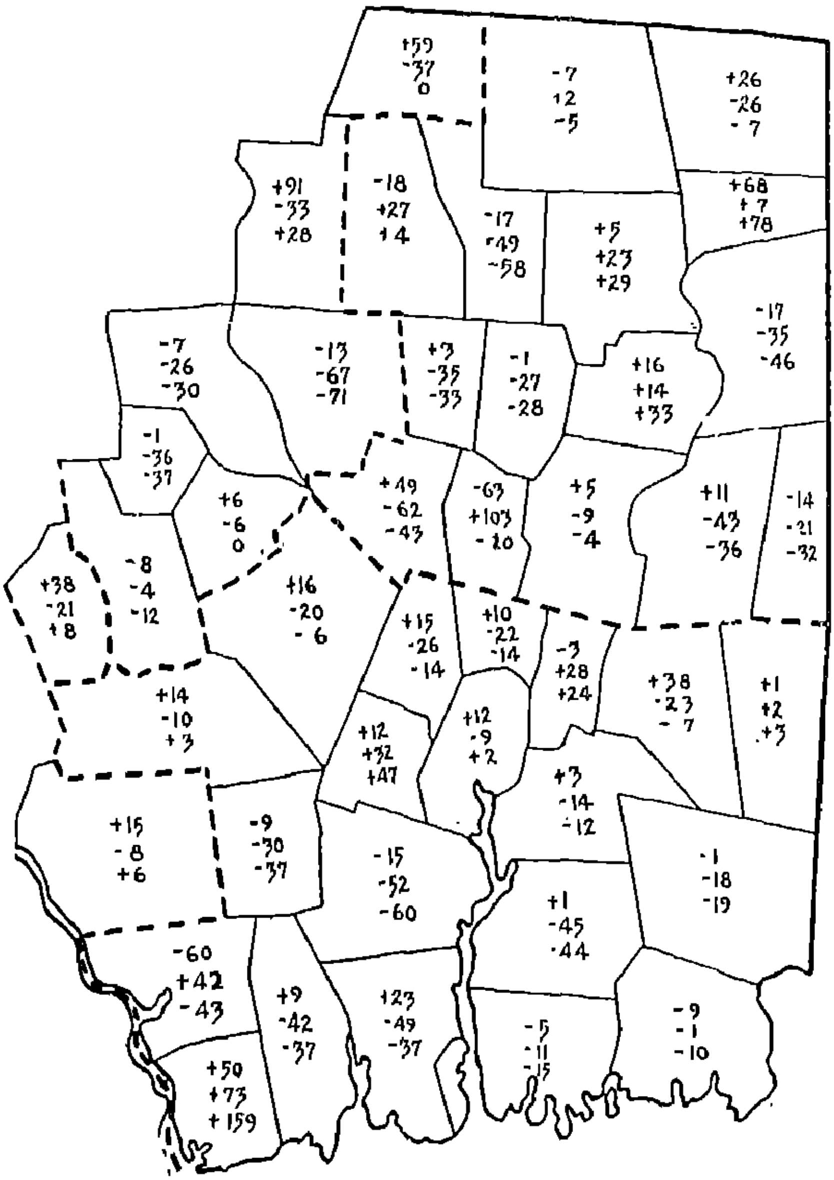
We may now discuss the significance of such frequency distributions. Superficially they are a picture of the differences in the rates of change in the number of farms reported by the Census in a series of given towns as compared with all towns adjoining each given town. The frequency distribution summarizes the situation for an area.

If Census enumeration and tabulation are complete, accurate, and the same definitions of terms in the schedule applied with perfect consistency among towns and between periods of enumeration, then the

CHART I

PERCENTAGE CHANGE IN NUMBER OF FARMS IN EASTERN CONNECTICUT HIGHLAND

Upper figure, 1920–25. Middle figure, 1925–30. Lower figure, 1920–30.



results must reflect the changes which actually occurred. If, on the other hand, there exists complete homogeneity with relation to the operation of the forces causing change in the number of Census farms, places occupied by a family, and having over three acres of land or producing over $250 of product, then the differences appearing must be almost entirely the result of inconsistency in definition, faulty enumeration, or both. Since neither complete consistency and accuracy of enumeration or complete homogeneity prevails, the differences in rates of change observed are probably ascribable to both causes. In any particular case it becomes a question of determining in some degree the weight to be attached to each set of causes. The method described above was applied to the data for the townships of the Eastern Connecticut Highland. The frequency distribution of the extent which the percentage change of each township was in excess or deficit of the average percentage change of all its adjoining townships is shown in Chart II.

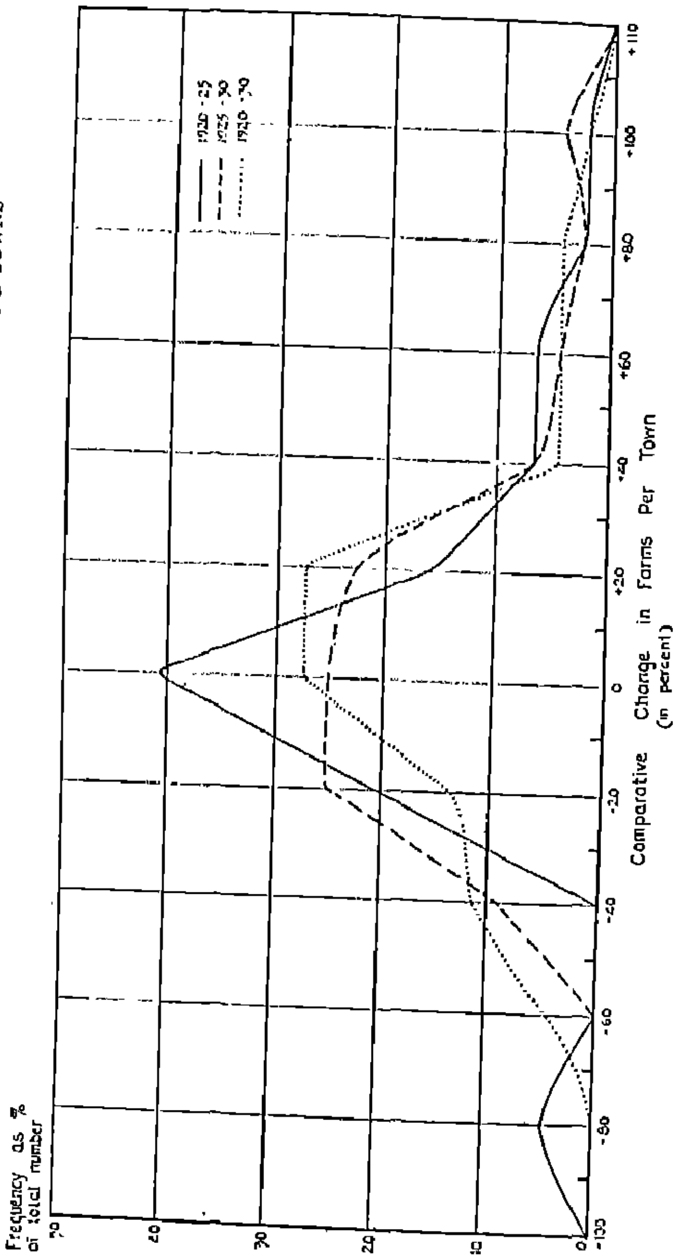
The Eastern Connecticut Highland is almost entirely upland in character, interspersed with numerous narrow valleys. Soils are diverse but so scattered that most of the soils can be found in any one town. There are no large cities. The small cities are quite evenly scattered throughout the area and between are the numerous small industrial villages occurring in practically every township. The area is one that appears to be quite homogeneous with respect to the operations of any forces that might cause change in the number of farms being reported under the terms of the Census definition. It is, furthermore, a matter of common and general observation that the farm houses on farms reported in the 1925 Census were still there in 1930, and that agricultural operations were being conducted on them—often on a part-time basis—but not so reduced as to disqualify the farms for classification as Census farms.

After the frequency distributions plotted in Chart II had been examined, the mean and the standard deviation of each series were computed. The standard deviation of the series based on the 1920–25 Census was 33.6; of the series based on the 1925–30 Census, 33.9; and of the series based on the 1920–30 Census, 35.0. It should be noted that in all three distributions, particularly the one representing the changes between 1925 and 1930, there are a number of cases of towns which show a very wide difference in the direction and amount of change as compared with adjoining towns. In most instances these towns are in territories where soil type and the character and density of population are similar.

A means was sought of determining whether the changes in the num-

CHART II

FREQUENCY DISTRIBUTION OF PER CENT CHANGE IN NUMBER OF FARMS IN EACH TOWN IN EASTERN HIGHLAND AS COMPARED WITH PER CENT CHANGE IN ADJOINING TOWNS



bers of farms in townships were relatively more unstable, and more subject to haphazard change due to errors or bias in enumeration than were the changes in the number of farms in larger units such as a county. Within the county, the errors, failures to enumerate, and personal bias of each of a number of enumerators would have a tendency to cancel each other. It was decided, therefore, to take the counties of Southern New England and treat them in the same manner as the townships of the Eastern Connecticut Highland had been treated. The area of Southern New England taken as a whole is less homogeneous than the Eastern Connecticut Highland. It contains counties that are highly agricultural like Litchfield County, Connecticut, Franklin County, Massachusetts, and Washington County, Rhode Island. It contains a number of counties where industry and commerce are highly developed. It contains upland and valley counties.[1] As compared with the Eastern Connecticut Highland, the area is diversified and considerable variations in the amount and direction of change between a county and adjoining counties might well be expected. Frequency distributions, however, of the deviations of the change in each county from the changes in adjoining counties computed in a similar way to the data used in Chart II exhibit much less dispersion than the series there shown. The standard deviations of these distributions are 15.27 for 1920–25, 16.31 for 1925–30, and 15.52 for 1920–30. It appears that the dispersion of this series is less than half of that exhibited in the case of the Eastern Connecticut Highland. We conclude, therefore, that there is strong evidence in the comparison of these two distributions and their dispersions, that the numbers of farms reported in townships are erratic, and that they cannot be depended on to be comparable either with adjoining towns or other periods of enumeration. This is no evidence of the accuracy of county totals, which, as will be shown later, tend to have a downward bias.

While the results thus far reported in this paper make it seem probable that marked inconsistencies exist in the results of tabulated Census enumeration, they throw no light on the causes of these inconsistencies nor do they positively show whether the inconsistencies exist. They do, however, create a very strong presumption that such is the case. To confirm this presumption it is necessary to use some unbiased body or bodies of data with which to check the results of the Census tabulation.

Two such bodies of data were found to be available for the Eastern Connecticut Highland. The first is the schedule of a type of farming

[1] Suffolk County, Massachusetts, in which Boston is located, and Dukes and Nantucket, two island counties, were omitted.

survey that had been made in twelve townships in the Eastern Connecticut Highland by the Connecticut State College coöperating with the United States Department of Agriculture, soon after the Census enumeration. Schedules were obtained in one township in the summer of 1930 and the work was completed in May, 1931. The enumerators in the survey were instructed to visit every house or residence outside of the compact villages, and if such proved to be a farm within the scope of the Census definition—that is, if it possessed three acres or more of land—they were instructed to secure a record on this place. The record included the number of acres of different kinds of crops, the number of different kinds of livestock, and other items. These townships were located in the open country—that is, they did not contain large boroughs or large manufacturing villages—and there was in these towns little of that kind of part-time farming which may be classified as suburban part-time farming. Of the farms found by this survey, while over 99 per cent had qualified in respect to acreages according to the Census definition, 523 were classified as residence farms, 613 as commercial part-time farms, 401 as specialized dairy farms, 81 as dairy-poultry farms, and the remaining 509 were of miscellaneous full-time agricultural types. Table I shows the comparison of the 1930 Census with the result of the type of farming survey in twelve towns in the Eastern Connecticut Highland.

It will be observed from this table that there are two townships in which the number of farms reported by the Census is 22 per cent less than the number found by the survey, and that there is one town in which the number found by the Census is 40 per cent less than the number found by the survey. For the twelve towns as a whole, the Census found 10 per cent less acres, 10 per cent fewer cows, and 15 per cent fewer head of young stock than in the survey.

While there is but one township in the twelve township sample in which the rate of change varies more than 40 per cent from the rate of change in adjoining towns, there are in the Eastern Connecticut Highland as a whole eleven townships out of forty-five which vary more than 40 per cent in the rate of change in the adjoining towns. It is probable that the deviation of the Census and the results of our survey in the twelve sample towns is not so great by a considerable amount as it would have been in the area as a whole if a similar survey had been made in the entire area. The results of the twelve sample towns, in other words, made out a better case for the Census from the standpoint of consistency than is actually justified.

A further interesting comparison is that between the per cent of deviation in number of farms of the 1930 Census from the survey, and

TABLE I

COMPARISON OF CENSUS WITH A TYPE OF FARMING SURVEY ON TWELVE TOWNS IN THE EASTERN HIGHLAND AREA

Town	Number of farms			Acres in farms			Number of cows			Total number kept for present and future dairy			Acres silage		
	Survey	1930 Census	Per cent deviation, Census from survey	Survey	1930 Census	Per cent deviation, Census from survey	Survey	1930 Census	Per cent deviation, Census from survey	Survey	1930 Census	Per cent deviation, Census from survey	Survey	1930 Census	Per cent deviation, Census from survey
Ashford	129	131	+ 2	18,036	16,665	− 8	509	428	−16	842	735	−13	73	43	−41
Brooklyn	109	121	+11	11,344	12,594	+ 1	583	623	+ 7	898	884	− 2	136	117	−14
Canterbury	222	173	−22	20,513	18,536	− 9	840	809	− 4	1,353	1,216	−10	166	116	−30
Columbia	130	128	− 2	11,031	9,980	−10	619	553	−11	922	782	−16	113	89	−21
Coventry	240	178	−26	17,993	14,681	−18	973	978	0	1,608	1,373	−15	245	200	−19
E. Haddam	245	223	− 9	20,604	21,354	+ 4	867	843	− 3	1,343	1,229	− 8	139	116	−17
Griswold	161	130	−19	19,024	14,308	−25	736	518	−30	1,207	804	−33	186	112	−40
Marlboro	67	52	−22	12,188	7,784	−36	367	339	− 8	563	500	−11	65	57	−12
N. Stonington	201	179	−11	25,099	22,826	− 9	923	861	− 7	1,535	1,277	−17	212	220	+ 3
Stonington	156	149	− 4	16,413	13,567	−17	884	690	−22	1,414	1,259	−11	201	208	+ 2
Waterford	181	92	−49	12,110	7,981	−34	1,036	748	−23	1,539	1,059	−31	250	130	−48
Woodstock	289	288	0	17,712	21,569	+22	1,475	1,487	+ 1	2,380	2,210	− 6	289	285	− 1
Total	2,130	1,644	−13	202,067	181,885	−10	9,812	8,877	−10	15,604	13,328	−15	2,075	1,691	−19

the deviation of the 1930 Census from the 1925 Census. The results of such comparison are shown in Table II.

TABLE II

PER CENT DEVIATION IN NUMBER OF FARMS OF THE 1930 CENSUS FROM THE SURVEY AND THE 1925 CENSUS

Town	Per cent change from 1925 to 1930 Census	Per cent deviation 1930 Census from survey
Ashford	+27	+ 2
Brooklyn	+14	+11
Woodstock	+ 2	0
Stonington	− 1	− 4
Columbia	− 6	− 2
E. Haddam	− 8	− 9
Canterbury	− 9	−22
N. Stonington	−18	−11
Marlboro	−21	−22
Griswold	−23	−10
Coventry	−26	−26
Waterford	−40	−40

It is apparent from the above that the towns which showed a marked decrease in the number of farms between 1925 and 1930 were in every case the towns in which the survey revealed a significantly greater number of farms than the Census. The conclusion is obvious. These farms had not disappeared. The Census failed to enumerate them.

The results presented thus far make it evident that one of two things must have happened. Either the enumerators in some towns were much more efficient and painstaking in their work than in others, or there must have existed a different conception on the part of enumerators of the definition of a farm. Lack of standardized definition might have very easily given rise to all the inconsistencies discovered, particularly in an area where so many borderline cases exist as is the case in part-time farming areas. A careful examination of the instructions issued to enumerators, both with relation to the agricultural Census and the population Census, indicates that the effect of the entire body of instructions was such as would be likely to lead to confusion on the part of enumerators as to the definition of a farm and to a lack of standardization of the definition among enumerators in the area as a whole.

This leads to the conclusion that in the Eastern Connecticut Highland, and probably throughout Connecticut, township data are unreliable largely because of incomplete enumeration. The primary cause of this is the unstandardized and subjective interpretation on the part of the enumerators of the definition of a farm and the instructions relating to the cases in which farm records should be obtained. The bias is almost always downward and affects the item "number of farms" most significantly, but it also throws into error all other items in the schedule by varying amounts.

An effort was made in one case to substantiate the belief that the definition of a farm used by the enumerators was subjective and varied greatly from town to town. Two adjoining towns were selected, Ashford, in which according to the Census the number of farms increased from 103 to 131, or 27 per cent during the 1925–30 interval, and Mansfield where the number of farms was reported by the Census as decreasing from 238 to 79, a decrease of 66 per cent. The writer has maintained his residence for the past seventeen years near the boundary line between these two towns and has been in close contact with the entire area. Since he had failed to observe any significant differences in the directions of change of the two areas during this period, the Census returns were surprising. A rough check was devised using tax assessors' returns. Since each tax payer is required to make and swear to such returns annually and subject to penalty for failure, considerable reliance may be placed in returns on important tangible items. An effort was made, therefore, to determine the notion or definition of a farm in the mind of the Census enumerator by checking his performance with the tax returns for the same year.

It was assumed that the enumerator in either town may have had in mind one of three definitions of a farm. Under the "A" definition he would think of a farm as any place occupied by a family and having three or more acres of land, a dwelling and a barn. Under the "B" definition, he would think of a farm as having the above land and buildings and a cow or cows or poultry or both. Under the "C" definition he would think of a farm as having a minimum business represented by the equivalent of at least three cows. The enumerators may have had any one of these definitions in mind or some intermediary definition.

TABLE III
ASHFORD

Census year	Number of farms				Number of acres			
	A	B	C	Census	A	B	C	Census
1925	173	111	91	103	10,570	13,353	10,976	14,134
1930	160	107	85	131	18,003	12,208	10,410	10,065

TABLE IV
MANSFIELD

Census year	Number of farms				Number of acres			
	A	B	C	Census	A	B	C	Census
1925	334	218	124	238	18,028	16,471	12,133	21,038
1930	327	175	104	70	20,856	13,334	10,065	9,300

It is apparent from Tables III and IV that in the town of Ashford the enumerators between 1925 and 1930 shifted from a definition between the B and C position to one between the A and B definition.

In the town of Mansfield, however, the enumerators during the same half decade shifted from a point midway between the A and B definition to one significantly below the C, approximately a D definition if one had been set up. Thus we have here two adjoining towns in which the Census returns exhibited marked divergence in the direction of change, and in which the change is actually largely in the shifting viewpoints of enumerators as to what constituted a Census farm.

The total amount of error appearing as the result of the defects of enumeration may be considered from the point of view of either one of two standards. It may be considered either from the standpoint of comparison with complete enumeration, assuming an adherence to the minimum definition of a farm set forth in the Census, or, second, from comparison with the standards of performance in the 1925 and the 1920 Census. With relation to the first standard we have no basis of judgment. Dr. David Rozman estimates that approximately one-half of the 33,000 farms found in the 1925 Census in Massachusetts were part-time farms, and that there were about 25,000 to 30,000 more which the agricultural Census did not find.[1] He estimated the annual value of the agricultural products of these farms as about $17,000,000 in 1929. Rozman's findings would at first thought lead us to believe that the 1925 and the 1920 Census omitted many part-time farms. There is no way of knowing, however, just what proportion of the part-time farms not enumerated by the Census but estimated or found by Rozman would qualify as farms under the Census definition. In comparison with the 1925 and the 1920 Census, however, we know that the 1930 county and state totals are in deficit by an unknown amount, probably in excess of 15 per cent of the number of farms and 10 to 15 per cent in respect to many of the other items as compared with the 1925 Census.

For the eight counties of the state, decreases appear in the number of farms reported in the 1930 Census as compared with the 1925 Census ranging from 18 to 39 per cent. For the three eastern counties of the state taken as a unit, the average decrease is 18 per cent. These three counties constitute the Eastern Connecticut Highland. The twelve sample townships which were used for check purposes show a decrease of 11 per cent in the Census returns. The 1930 check survey reveals

[1] See *Proceedings of International Conference of Agricultural Economists*, Ithaca, New York, 1930, p. 281.

the presence of more farms than were found in the 1925 Census. Since it has already been pointed out that this sample contained fewer towns showing marked decline than appeared in the area as a whole, there is reason to believe that the decline in the number of farms reported in the Census for these three counties did not actually occur, but that the lower figures are largely the result of faulty enumeration. The other five counties are in more highly industrialized and commercialized sections where suburban developments have proceeded more rapidly than in the three eastern counties. There has undoubtedly been in these five other counties both an increase in part-time farming and some movement of land out of farms into urban uses or summer residences. In view of the deficiencies of enumeration in the Eastern Connecticut Highland, it seems reasonable to believe that similar deficiencies occurred in the other five counties of the state. To persons thoroughly acquainted with conditions in these counties, it appears probable that there has been little if any decline in the number of farms that would qualify under the terms of the Census definition. The reported number of farms, therefore, is probably in error by an amount somewhere between 15 and 25 per cent.

Because of the fact that the farms omitted were in most cases part-time farms, these errors in enumeration do not have proportionately as important an effect on the reported number of cattle and acres of crops as they do on the number of farms. Nevertheless they create a sufficient degree of error to make comparisons between state totals and county totals for 1925 and 1930, or for 1930 and any previous Census of little value. If we had positive knowledge of the extent of the error appearing in any total, it would be possible to make corrections. Such evidence, however, is lacking.

TABLE V

SHOWING TOTALS AND AVERAGE FIGURE PER FARM ON CERTAIN ITEMS
IN CONNECTICUT, 1925 AND 1930[1]

	1925	1930
Total number farms	23,240	17,195
Total acres	1,832,110	1,502,270
Average size of farm (acres)	78.8	87.4
Total number cows	112,623	94,028
Average number milk cows per farm	4.85	5.47
Total number chickens	1,638,000	1,530,725
Average number chickens per farm	70.5	89.0
Crop land harvested (acres)	497,435	372,147
Average crop land per farm	21.4	21.6

[1] From the Fifteenth Census of the United States, 1930. Agriculture, Vol. II, pp. 224–226.

Table V shows the total and average number of acres, cows, chickens, and crop land harvested for Connecticut in 1925 and 1930. It will be

observed that the totals have in every case declined during the 1925–30 interval, in some cases significantly, and that the average size of farm has increased. If we have in mind the Census farm defined according to a standardized definition over the two Census periods, we are left in a state of doubt as to what has actually occurred.

Since the Census totals are an important basis for the projection of crop and livestock estimates by the Federal Service and are used by numerous agencies in the formulation of policy, a fair degree of accuracy is necessary. When used for purposes of comparison with 1925, the 1930 state totals are probably sufficiently in error so that no creditable conclusions can be drawn regarding the trends of agriculture during this interval.

Let us now consider for a moment the extent to which the conclusions appearing for Connecticut are applicable to the northeastern United States. The number of farms reported in each of the northeastern states fell off significantly from 1925 to 1930. The range of decline was from about 14 per cent in New Jersey and Pennsylvania to 29 per cent in New Hampshire. These figures are strikingly similar to the changes in counties in Southern New England. There seems little reason to doubt that the same lack of standardization in the definition of a farm operated throughout the part-time farming area of the northeast introduced a considerable but unknown amount of error into all Census totals. It also rendered comparisons among minor civil divisions for the 1930 period, and between state, county and regional totals for the 1925 to 1930 period, of very dubious validity.

This paper is presented in no wise as a general indictment of the Census. The tremendous difficulties facing the Census Bureau and the success with which it has attacked many phases of its great task are appreciated.

The great variations which occur in the character of the farm over the area of the United States, the range of type of farming from part-time farming near cities to the ranches of Texas and the West, and the diversity of conditions of tenure, make it difficult to set up one general definition of a farm and one general set of instructions covering that definition which will be interpreted unambiguously by inexperienced enumerators throughout the United States. The inconsistency resulting from subjective definition of a farm is an excellent example of uniformity of instructions producing erratic results and breaking the continuity of series because of the diversities appearing in the area of enumeration. In the part-time farming areas the inconsistency among enumerators in their definition of a farm has given rise to errors in totals of all the items appearing in the schedules. This experience raises the

important question of how such difficulties may be avoided in the future. While the solution of the problem lies with the Census Bureau, the question may be asked as to whether the solution may not lie in part along the following lines:

1. Enumerators might be instructed to secure schedules on all possible cases both from farms and part-time farms and classification be made in the central office rather than being left to the judgment of the enumerator in the field.

2. Special supplementary instructions might be prepared for each part of the United States where important inconsistencies have appeared in the past and an effort made to give personal instruction to enumerators in groups or singly.

3. Census enumerators might be appointed on a basis of merit, rather than of political preferment.

4. Special advisers thoroughly familiar with conditions in various parts of the United States might be asked to help in adopting schedules, instructions and training of enumerators.

The accuracy of the Census results, the preservation of the continuity of Census series, and the comparability of results over time and between areas are all matters of great importance. Accuracy and comparability are not only important with relation to national and state results, but with relation to the results in counties and minor civil divisions. The agricultural Census is our fundamental body of basic data as to inputs and outputs, as to farm and social organization. On it are based our national and many state livestock and crop reporting and estimating services, and numerous other statistical projections and estimates. National and local policies are built on its results.

It appears to the writer that nothing can contribute more to the improvement of the Census and that nothing should be more appreciated and welcomed by those responsible for its administration than a very active and lively interest on the part of all research agencies in determining the nature of its weaknesses and discussing and investigating methods of improvement. It is further important that agencies using the Census as a basis for either public or private policy should be guarded against its defects. It is even more necessary that they come to appreciate the indispensable character of its results when such results are accurate and capable of a consistent interpretation.

THE ALLOCATION OF HIGHWAY COSTS AMONG CLASSES OF MOTOR VEHICLES FOR PURPOSES OF CALCULATING GRADUATED TAX SCHEDULES[1]

By Arch D. Schultz, *Ohio Chamber of Commerce*

When Thomas H. MacDonald, Chief of the Bureau of Public Roads, appeared at the hearing of the Interstate Commerce Commission in Docket 23,400 on March 4 and 5, 1932, he stated that a 7½ ton truck equipped with pneumatic tires and operating at 30 miles per hour required a concrete road of thickness 15 per cent greater than that required for a seven passenger automobile. Furthermore, said Mr. MacDonald, if such a truck is equipped with cushion tires and operates at only 20 miles per hour, an increased thickness of 31 per cent is required. If the truck is equipped with solid tires, the necessary thickness exceeds that for the seven passenger car by 42 per cent. Moreover, Mr. MacDonald indicated that if the roughness of the highway exceeds that of fair sheet asphalt, even heavier construction is required. These statements were based upon the results of engineering research.

Thus, engineering studies directed by an engineer of nation-wide fame offer data upon which may be based a method of calculating a distribution of roadway costs among various classes of vehicles. The problem is one of allocating the outlay for thicknesses, widths, and other construction requirements among the various classes of vehicles, proportioned among vehicles according to the construction costs necessitated by the operation of each class.

For some time the Bureau of Public Roads conducted experiments to determine the effect of climate and of stresses occasioned by the operation of various classes of vehicles on the service life of highways. These studies show that to resist the warping effect of the sun's rays and the effect of frost, the minimum thickness of a cement slab must not be less than 7 inches at edge and 6 inches at center except in the northern states where requirements are slightly greater. In the matter of the effect of vehicle operation it was found that loadings and types of tires are the most significant factors in damage caused by wheel impacts. Variation in operating speeds may be ignored up to 45 miles per hour. Furthermore, according to the engineers in the United States Bureau of Public Roads, curvature and grade are negligible factors.

It was ascertained that concrete roads designed to resist weather

[1] This is a revision of a paper prepared for the Ninety-fourth Annual Meeting of the American Statistical Association on December 29, 1932. Accident prevented its delivery there.

conditions provide sufficient thickness to carry without damage all passenger cars and 2 and 3 ton capacity trucks loaded only to rated capacity, if the loading of such trucks does not exceed a 5,600 pound rear wheel loading. Such trucks, however, must be equipped with dual tires of 6 and 7 inches in diameter. Commercial vehicles of the 3 ton class do not normally exceed 8,500 pounds and when fully loaded have a maximum gross weight of approximately 14,500 pounds. Traffic tests show that in the case of trucks, 60 to 80 per cent of this weight is carried on the rear axle. Thus, all trucks up to 3 ton capacity, if they are not overloaded, are within the maximum limit for rear wheel loads of 5,600 pounds. The thickness required for such loads is adequately provided for in the 7–6–7 inch highway, that is, the specification requirements to resist climatic effects.

However, when we come to the 5 ton capacity trucks, which when loaded have a gross weight of at least 22,000 pounds, an additional thickness of 8 per cent is required if the impact reaction during operation is to be fully resisted without damage to the highway. The tests made by the Bureau of Public Roads covered 9,000 pound rear wheel loadings, hardly adequate for most modern trucks rated to carry 5 ton loads. Further thickness is required for the 7½ ton trucks and for the 5 and 7½ ton vehicles not equipped with pneumatic tires. Practically speaking, few trucks are sold which are rated at 7½ tons capacity. Overloaded 5 ton trucks and large passenger busses fall into the class of 7½ and 10 ton vehicles.

What has been said of trucks applies to passenger busses since there is no difference, as far as the road is concerned, between the weight of passengers and the weight of property carried. Furthermore, the vehicle weight of large busses exceeds that of trucks—a 45 passenger bus normally weighs in excess of 20,000 pounds.

In addition to the weight of vehicles as a factor in highway costs, there is the factor of width requirements to accommodate traffic with reasonable safety. Private passenger cars do not normally exceed 6 feet in width. Motor busses as a class are 8 feet wide and often are 30 feet long. Motor trucks commonly are 8 feet, 6 inches in width and are as long as 80 feet. Thus, for safety, to accommodate these larger vehicles, an increased highway width is required, including especially designed curves both as to roadway width and radius of curvature.

With this brief review of fundamental facts, I wish to present a method for calculating a distribution of highway costs among various classes of vehicles which, with proper interpretation, will give some notion of the relative tax burden which may be assigned by a state to various classes of motor vehicle property. It is impossible in the

space available to include in this discussion the various refinements in the method or to apply the principle to any actual situation. It is thus impossible to consider miscellaneous items of expenditure in the highway program such as snow removal, traffic control, and bridges.

It is not possible to state incontrovertibly that any significant part of bridge costs should be attributed to heavy vehicles as distinguished from the ordinary passenger car and light truck. Bridges have to be designed to carry heavy loads which might be imposed upon them and which might not even reasonably be charged to motor vehicle traffic at all. For instance, bridges must be built to carry ditching machinery, road-building machinery, and other contingencies of heavy loading.

If it be true that heavier bridges have to be constructed to carry the heavier vehicles, they entail an unknown and incalculable additional cost above lighter specifications. There is tremendous variation in the cost of similar load capacity bridges, due to varying conditions of topography at the site. Thus, it is practically impossible to determine what, if any, extra costs are entailed in constructing bridges to carry a 15 ton vehicle instead of a 5 ton vehicle. Some estimates vary from 2 to 35 per cent. For these reasons it has seemed advisable to make no attempt to charge any part of the cost of bridges to heavy vehicles.

Because of certain engineering features of grade separation it cannot reasonably be said that large and heavy vehicles should bear any special charges for this purpose. It is commonly reported that a higher clearance, when the grade separation is undergrade, is required to accommodate large vehicles, particularly moving vans. As a matter of fact, under the engineering policy of most highway departments a minimum of 500 feet sight distance is allowed in all construction of grade separations. This means that an approaching vehicle must at all points along the highway be able to see the surface of the highway 500 feet ahead. Normally, a 14 foot clearance undergrade is required. Most vehicles do not require more than 13 feet of clearance. In those cases where 13 feet of clearance is adequate for sight distance, no extra charge can reasonably be placed against the larger vehicles, because the only additional cost which could be charged against them is the extra foot of excavation of subgrade. The total cost of this extra foot for a normal separation, at $.35 per square yard, does not exceed $300, an item too insignificant for allocation processes.

Paving costs on overheads and undergrades are adequately taken care of in the calculations to follow.

In the allocation of highway costs among vehicles the separation of maintenance and repair costs from new construction costs need not be made. This is true for two fundamental reasons:

(1) Highway development is a governmental function and normally will be continued as a public project and as a more or less fixed element in governmental budgets. The annual outlay will not greatly vary from year to year. The allocation of expenditure for either maintenance or new construction will be dictated largely by the physical condition of the highways in each jurisdiction.

(2) The distribution may be looked upon as being always one of new construction since the real cost to be charged against each vehicle is ideally that part of the total cost of a highway which is required to *provide a road which that vehicle cannot destroy or damage. In other* words, the vehicle must either pay for such a construction or be charged for the repairs or reconstruction.

For purposes of deriving indexes of relative costs to be allocated, it seems advantageous to distribute among various classes of vehicles the cost of one mile of concrete highway since the average cost of high type construction is well represented by the cost of concrete roadway. This is found to be approximately $30,000 per mile for a complete construction 20 feet wide, including subgrade, structures and small bridges. Furthermore the tests of the Federal Bureau of Public Roads were *made upon such a surface.*

To simplify the analysis, and because it is approximately correct, it will be assumed that $20,000 per mile represents the cost for the slab and $10,000 per mile the cost of subgrade. The item for subgrade may be somewhat high. The effect of this in the distribution of costs will be to undercharge the heavier vehicles.

It has seemed reasonable to charge to the larger vehicles the cost for widths over 16 feet. Specifications for safe operation of large vehicles require roads at least 20 feet wide, and it will therefore be assumed that the mile of highway upon which the calculation is based is 20 feet wide.

Chart I presents the point of view for distributing among six classes of vehicles the cost of a pavement 8½ inches thick and 20 feet wide. The plan shows the distribution of the cost of that part of a given slab which is required to resist climatic effects and the minimum width required for small vehicles, *among all classes of vehicles* proportioned according to the number of units in each class. The cost of 16 feet of the subgrade is similarly distributed.

The extra 4 feet in the width of the slab 7 inches thick and the 4 feet extra subgrade is charged equally to all vehicles over 3 tons capacity, since this block of the cost is required only for the wide and heavy vehicles.

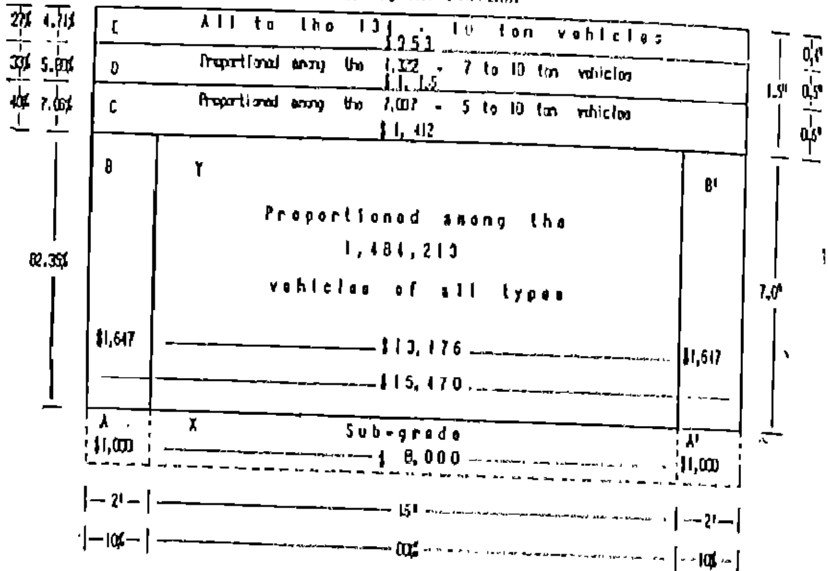
And finally, among the classes of heavy vehicles of over 3 ton capacity

the thickness over 7 inches which is required to resist impact reactions is distributed among the heavy vehicles according to the number actually in each class and the extra thickness required by each class.

CHART I

BASES FOR DISTRIBUTION OF COST

Highway Cross Section



Sections X and Y are chargeable to all vehicles.
Sections A, A¹, B, and B¹ are chargeable to all vehicles over 3 ton capacity.
Sections C, D, and E are chargeable only to heavy vehicles.

DISTRIBUTION OF COST OF CONSTRUCTION

Cost of subgrade and slab, $30,000, divided as follows: Subgrade 20 feet wide, $10,000; concrete slab 20 feet wide, $20,000.

Distribution of Subgrade Cost:

Section X = 80% of $10,000 or $8,000, distributable among all vehicles.
Sections A and A¹ = 20% of $10,000 or $2,000, distributable among heavy vehicles.

Distribution of Cost of Concrete Slab 20 Feet Wide:

Sections B, Y, and B¹ = 82.35% of $20,000 or $16,470.
Section Y = 80% of $16,470 or $13,176, distributable among all vehicles.
Sections B and B¹ = $16,470 − $13,176 or $3,294 ($1,647 for each section) distributable among all heavy vehicles.
Sections C, D, and E = $20,000 − $16,470 or $3,530.
Section C = 40% of $3,530 or $1,412.
Section D = 33% of $3,530 or $1,165.
Section E = 27% of $3,530 or $953.

In this distribution it is necessarily assumed that extra thickness of concrete is laid at proportionally extra cost.

Table I shows the necessary arithmetic calculations.

If it is intended to fix the schedule of license fees on the basis of re-

quired construction costs instead of a schedule arbitrarily determined, the rate relationship may be derived from the results of Table I. Table II shows the relative rate schedule derived from an allocation of

TABLE I

CALCULATION OF DISTRIBUTION OF COST OF ONE MILE OF CONCRETE HIGHWAY AMONG CLASSES OF VEHICLES

(Pneumatic Tires)

A. *Basic Data*

Class of vehicles	(1) Estimated maximum gross weights* (pounds)	(2) Estimated average rear axle loading* (pounds)	(3) Actual rear wheel loads at tests (pounds)	(4) Actual test maximum impact force (pounds)	(5) Index of required minimum thickness to resist impact	(6) Actual required thickness of slab in inches
(1) Passenger cars...	7,000		1,750	5,100	1.000	7.0–6.0–7.0
(2) 2 ton trucks.....	8,500	6,000	4,400	7,000	1.000	7.0–6.0–7.0
(3) 3 ton trucks.....	12,750	9,053	5,600	9,200	1.000	7.0–6.0–7.0
(4) 5 ton trucks.....	21,250	15,300	9,000	12,500	1.077	7.6–6.5–7.6
(5) 7½ ton trucks..	31,875	23,200	11,000	14,600	1.154	8.1–6.9–8.1
(6) 10 ton trucks....	42,500	31,875			(Est.) 1.220	8.5–7.3–8.5

* Includes load.

B. *Bases of Distribution*

Class of vehicles	(7) Estimated weight of vehicles (*pounds*)	(8) Number of vehicles in a given *state*	(9) Per cent of total	(10) Number of vehicles over *3 tons*	(11) Per cent of total	(12) Number of vehicles over *5 tons*	(13) Per cent of total
(1) Passenger cars	6,000	1,335,012	90.008				
(2) 2 ton trucks...	4,500	134,717	9.077				
(3) 3 ton trucks...	7,500	6,547	.441				
(4) 5 ton trucks...	11,250	5,715	.385	5,715	81.22		
(5) 7½ ton trucks	16,875	1,188	.080	1,188	16.88	1,188	89.86
(6) 10 ton trucks..	22,500	134	.009	134	1.90	134	10.14
Total..........		1,484,213	100.000	7,037	100.00	1,322	100.00

C. *Distribution of Cost of Sections of Roadway among Classes of Vehicles*

Class of vehicles	(14) Section X. Basis, column 9	(15) Section Y. Basis, column 9	(16) Sections A,A'. Basis, column 11	(17) Sections B,B'. Basis, column 11	(18) Section C. Basis, column 11	(19) Section D. Basis, column 13	(20) Section E	(21) Total of columns (14) to (20)	(22) Column (21) divided by column (8)
(1) Passenger cars..	$7,201*	$11,850						$19,060	$0.014
(2) 2 ton trucks....	726	1,196						1,922	0.014
(3) 3 ton trucks....	35	58						93	0.014
(4) 5 ton trucks....	31	51	$1,624	$2,675	$1,147			5,528	0.967
(5) 7½ ton trucks**.	6	11	338	556	238	$1,047		2,196	1.848
(6) 10 ton trucks**..	1	1	38	63	27	118	$953	1,201	8.963
Total...........	$8,000	$13,170	$2,000	$3,294	$1,412	$1,165	$953	$30,000	

* $7,201=90.008 per cent of $8,000.

** Also may refer to 25–29 and 35–50 passenger busses.

construction costs which is necessary to replace a total annual license fee revenue of $15,000,000. The data in columns (1) and (2) are derived from an enumeration of motor vehicles by classes.

TABLE II

DISTRIBUTION OF REGISTRATION FEES AMONG VEHICLES REQUIRED TO REPLACE TOTAL LICENSE FEES OF $15,000,000

Class of vehicles	(1) Maximum vehicle weights (pounds)	(2) Number of vehicles	(3) Experimental and interpolated basic rates	(4) Total revenues	(5) Basic rates times $15,000,000 / $28,031,316 (.524)
Passenger cars	3,000	1,336,012	$14	$18,702,708	$7.34
½– 2 ton trucks and trailers	6,500	107,711	20	2,154,220	10.48
2– 3 ton trucks and trailers	7,500	4,430	45	199,350	23.58
3– 4 ton trucks and trailers	9,500	5,415	200	1,083,000	104.80
4– 5 ton trucks and trailers	12,500	3,703	967	3,580,801	506.71
25–29 passenger busses, and trucks	18,500	1,292	1,200	1,550,400	628.80
30–50 passenger busses, and trucks	24,500	87	1,848	160,770	968.35
Total		1,458,650		$28,031,316	

The ideal tax against motor vehicles would be that required for the support of the particular units of highways which a given class of vehicle utilizes. For instance, the private passenger automobile may be thought of as using the entire highway net of the state; local delivery trucks, only the streets of a given city; and inter-city busses, only those highways upon their specific routes. The foregoing suggestion has been applied to an hypothetical highway net as a whole and illustrated an allocation covering an entire highway system.

The proper use to be made of the method suggested, however, is to apply it to a separation of the state highway net into such groups as operating conditions warrant. A separate allocation process should be worked out for each of these groups based upon a proportioning of the different classes of vehicles operating on each of the highway groups, after determining a standard highway per mile cost for each of the classes of roads involved.

TESTS OF SIGNIFICANCE IN APPLYING WESTERGAARD'S METHOD OF EXPECTED CASES TO SOCIOLOGICAL DATA

By Samuel A. Stouffer, *University of Wisconsin* and Clark Tibbitts, *University of Michigan*

Westergaard's method of expected cases, as adapted by Woodbury,[1] seems to have possibilities of rather wide applicability in social studies where the unit is the individual and none of the factors studied are in quantitative form. It is important particularly because it provides a method of studying the relationship between two factors with one or more other factors held constant.

The purpose of this paper is two-fold: (1) The writers point out that the expected frequencies found by the Westergaard method are identical with the expected frequencies calculated in well-known tests of significance; and illustrate two out of various possible methods of interpreting the results of the Westergaard procedure in terms of probability. (2) The writers indicate, with numerical data on parole violation, a type of sociological material to which the Westergaard method, with appropriate tests of significance, seems particularly applicable. No new contribution to statistical theory is attempted. The writers simply have applied relatively well-established techniques in a new setting and have not hesitated here and there to retrace rather familiar ground, in the interest of readers who might like to make further practical applications.

Table I summarizes an analysis of two factors associated with success or failure on parole. It is thought that a punishment record for infraction of prison rules is associated with success or failure on parole, when failure on parole is defined as getting caught for violating parole. Consecutive records, obtained by Tibbitts, of 2,963 parolees from the Illinois State Reformatory, 1920–28, show that among parolees with no institution punishment record there were 405 violators of parole, or 221.7 per 1,000; among parolees with a record of one or two punishments there were 248 violators, a rate of 338.0 per 1,000; among parolees with three or more punishments there were 151 violators, a rate of 354.5 per 1,000.

[1] Harald Westergaard: *Die Lehre von der Mortalität und der Morbilität*, Jena, 1882, pp. 28–30; "Scope and Method of Statistics," this Journal, XV (1916) pp. 260–64. Robert M. Woodbury: "Westergaard's Method of Expected Deaths as Applied to the Study of Infant Mortality," this Journal, XVIII (1922) pp. 366–376; *Infant Mortality and Its Causes*, Baltimore, 1926. Chapter IV of this volume, in which the method is explained, is largely a reprint of Woodbury's paper in this Journal above cited

It might be, however, that the apparent differences in violation rate among prisoners are merely a function of some other factor or factors. For example, parolees with no criminal record previous to commitment to Pontiac violated parole at a rate of only 217.2 per 1,000, as compared with a violation rate of 412.5 per 1,000 among parolees with a penitentiary or reformatory record previous to commitment to Pontiac. A larger proportion of the latter group was punished while in Pontiac than of the former group. Perhaps, punishment record, by itself, was not associated with success or failure on parole, except as the differences in violation rates by punishment record merely reflected the influence of previous criminal record.

TABLE I

DATA FOR ANALYZING THE EFFECT OF PUNISHMENT RECORD IN PRISON ON PAROLE VIOLATIONS, APART FROM THE EFFECT OF PREVIOUS CRIMINAL RECORD

Records of 2,963 Parolees from Illinois State Reformatory, 1920–1928

Punishment record while in reformatory		Previous criminal record: No previous criminal record	Record of fine or probation	Industrial school record	Jail record	Penitentiary or reformatory record	Total*
No punishment	Total parolees	1281	150	150	161	73	1827
	Observed violators	248	32	48	51	26	405
	Expected violators	278.89	40.08	63.63	58.18	30.11	470.69
	$n_i p_i q_i$	218.31	29.37	37.68	37.54	17.09	340.59
	χ^2	4.37	2.22	0.48	1.37	0.05	15.39
	χ	−2.1	−1.5	−2.5	−1.2	−1.0	−3.6
1 or 2 punishments	Total parolees	307	68	99	99	47	710
	Observed violators	102	22	54	41	21	240
	Expected violators	86.23	18.17	40.38	35.12	19.30	199.20
	$n_i p_i q_i$	67.60	13.72	23.91	22.66	11.30	138.79
	χ^2	3.68	1.10	7.76	1.53	0.23	14.30
	χ	+1.9	+1.0	+2.8	+1.2	+0.5	+3.5
3 or more punishments	Total parolees	202	44	70	64	40	426
	Observed violators	50	16	33	24	16	151
	Expected violators	43.68	11.70	31.00	22.70	16.50	125.64
	$n_i p_i q_i$	34.35	8.62	18.36	14.65	9.09	85.66
	χ^2	0.68	2.00	0.22	0.12	0.04	0.73
	χ	+2.6	+1.4	+0.5	+0.3	+0.8	+2.2
Total	Total parolees	1883	262	331	327	160	2963
	Observed violators	409	70	135	116	66	706
	Violators per 1,000	217.207	267.176	407.855	354.740	412.500	268.647
	χ^2	14.71	5.41	14.46	3.02	1.62	30.42
	P	<.01	.07	<.01	.22	.41	<.01

*All entries except the last in each cell of this column are the sum of the entries in the corresponding row. For $\chi^2=15.39$, $P<.01$; for $\chi^2=14.30$, $P=.014$; for $\chi^2=0.73$, $P=.99$. The values −3.6, +3.5, and +2.2, as explained in the text, are obtained by referring the sum of the differences in a given row to its standard deviation $\sqrt{\Sigma n_i p_i q_i}$. They are to be interpreted as deviates of a normal probability curve and the respective probabilities (considering algebraic sign) are <.01, <.01, and .014. The values called χ in the individual cells are also to be interpreted as normal deviates and their probabilities may be found by reference to a table of the normal probability integral.

Among the 1,883 prisoners who had no criminal record previous to

commitment to Pontiac, 409 violated parole, a violation rate of 217.207 per 1,000. If punishment record were not a factor, the violation rate in each classification according to punishment record would have been the same. We take as the best available estimate of this the rate of 217.207 per 1,000. Therefore, instead of having only 248 violators among the 1,248 with no punishment record, our expectation would be $.217207 \times 1248 = 278.89$. (The fraction is retained for accuracy in further computation.) Similarly, instead of having 102 violators among the 397 with a record of one or two punishments, our expectation would be only $.217207 \times 397 = 86.23$. Finally, instead of having 59 violators among the 202 with three or more punishments, our expectation would be only 43.88.

These differences are large enough to suggest that punishment record did make a difference in the violation rates of the 1,883 parolees with no previous criminal record. Unless differences are obviously very great, it is important, before drawing conclusions, to see whether they might be accounted for by chance. Using the conventional formula for the standard error of a frequency, $\sqrt{npq}$, we find that each of these differences is significant, in the sense that it would be unreasonable to account for it by chance. For example,

$$\chi = \frac{248 - 278.89}{\sqrt{1248 \times .217207 \times .782793}} = -2.1$$

a negative normal deviate of a size occurring by chance less than once in fifty samples.

An analogous procedure may be carried through in the other four classifications according to previous criminal record. Table I shows in each sub-group the total number of prisoners; the number of observed and expected violators; the value of $\sqrt{npq}$; the value of χ, the normal deviate; and the value of χ^2, to be discussed later in this paper.[1]

SIGNIFICANCE OF THE SUM OF THE DIFFERENCES BETWEEN OBSERVED AND EXPECTED VIOLATORS

For some purposes, a study of the results as reported in the individual sub-groups may be sufficient. If it is desired to summarize the results, a method developed by Woodbury, is readily available. We may ask the question: If punishment record had not been a factor, how many expected violators would we have had among the 1,827 with no punishment records, as compared with the 405 observed violators found by adding the number of observed violators in each classification according

[1] The procedure is valid subject to the usual limitation that n and p must not be too small to justify using the normal curve as an approximation to the binomial expansion.

to previous criminal record? The sum of our five sets of expected violators is 470.89.

As before, we may inquire whether the difference between 405 and 470.89 is large enough to be reasonably accounted for by chance.[1] One method is simply to compute $\frac{n_0 - np}{\sqrt{npq}}$, where n_0 is the observed frequency, 405; n is the total number of parolees, 1827; p is the proportion of expected violators, $470.89/1827 = .257730$; and $q = 1-p$; yielding a value of $\sqrt{npq} = 18.70$ and indicating a significant normal deviate of -3.6.

An objection may be raised to this procedure on the ground that the expected number of violators, 470.89, is the sum of several expected frequencies based on varying estimates of p. The objection is certainly sound, theoretically. It may be questioned how serious it is, practically. A better estimate of the standard deviation than $\sqrt{npq}$ as above defined probably would be $\sqrt{Sn_s p_s q_s}$, where, in the s'th classification by previous criminal record, n_s is the number of parolees, p_s is the expected proportion of violators, and $q_s = 1 - p_s$. If we use this formula, we assume that our sum of observed violators, 405, is obtained from five independent subsets, the s'th subset being drawn from a hypothetical infinite population of possibilities in which the true proportion of violators is p_s. If we drew repeated samples of n_s parolees from this population with a fixed p_s, the observed numbers of violators in each sample would vary around the mean of $n_s p_s$ with a variance of $n_s p_s q_s$ and the sum of the observed numbers of violators in all the samples drawn from each subset would vary around the expected number $Sn_s p_s$ with a variance equal to the sum of the s individual variances. As is well known,[2] $Sn_s p_s q_s = npq - Sn_s\,(p_s - p)^2$. Our improved estimate of the variance always will be smaller than npq. In practice, however, the term $Sn_s(p_s - p)^2$ usually will be very small as compared with npq. In Table I the root of the sum of the five variances in the first row is equal to 18.46, as compared with $\sqrt{npq} = 18.70$, showing that the latter is in error by only a little over 1 per cent,

[1] Woodbury remarks: "In general, the calculation of such probabilities is likely to be misleading rather than helpful, since it tends to divert attention from the need of interpreting correlation in terms of real causes." (*Infant Mortality and Its Causes*, p. 58.) The same may be said, of course, of almost any study where a calculation of standard error inhibits further analysis. This is the fault, however, not of the standard error but of its user. Unless one has a vast number of cases, one is bound to find himself face to face many times with the task of trying to estimate whether an effect can be attributed to any cause other than chance; and it behooves him to satisfy himself by sound logical devices before he proceeds to the next step of asking, "Chance is not the cause; now is the real cause A, or is it B, C or D or all four of them?" Moreover, the present problem of testing significance, as this paper attempts to indicate, is relatively simple, not "abstruse" as Woodbury feared it would be. (*Op. Cit.*)

[2] Cf. H. L. Rietz, *Mathematical Statistics*, Chap. VI.

surely trivial considering the other errors implicit in the data. The values of $Sn_s p_s q_s$ for each classification by punishment record are given in the last column in Table I.

The aggregate number of observed violators in each of the classifications according to punishment record evidently differs from the expected number by an amount greatly in excess of what would be expected by chance if punishment record were not a discriminating factor. Of course, punishment record might still be a function of some third or fourth factor and not of itself really discriminating as between violators and non-violators.

TESTING SIGNIFICANCE BY THE χ^2 METHOD

Let us now introduce a somewhat different approach to the problem of testing whether the differences between observation and expectation may have arisen by chance.

Again, let us consider only those prisoners with no previous criminal record (Table II). By the usual χ^2 method we can estimate the numbers of violators and non-violators which we would have in each sub-class if chance alone accounted for the distribution, and if we drew repeated samples from a hypothetical infinite population in which the marginal frequencies were fixed. The expected numbers of violators would be

TABLE II

PAROLEES WITH NO PREVIOUS CRIMINAL RECORD

Punishment record	Violators	Non violators	Total
No punishments	${}_1m_1 = 248$	${}_2m_1 = 1036$	$n_1 = 1284$
1 or 2 punishments	${}_1m_2 = 102$	${}_2m_2 = 205$	$n_2 = 307$
3 or more punishments	${}_1m_3 = 59$	${}_2m_3 = 143$	$n_3 = 202$
Total	${}_1n = 409$	${}_2n = 1474$	$n = 1883$

exactly the same as those calculated by the Westergaard method, the expected number of violators with no punishment record, for example, being $409/1883 \times 1284/1883 \times 1883 = 278.89$, as before. We now test the hypothesis that the six observed entries in the table could have appeared by chance from a population yielding the given set of expectations. We have $\chi^2 = 14.71$, which is seen to be significant upon entering Elderton's or Fisher's table of χ^2 and P, allowing two degrees of freedom.[1] Our interpretation is that among parolees with no pre-

[1] That there are only two degrees of freedom is evident from the fact that all but two of the six expected values could have been filled in from the marginal totals by mere subtraction. If we had begun with some more complex hypothesis about the population from which we were sampling, the choice of degrees of freedom might have been different.

vious criminal record, the factor of punishment record does discriminate violators and non-violators to an extent greater than can reasonably be accounted for by chance. Repeating the procedure for other classifications by previous criminal record, we find that punishment record also discriminates in the case of those with an industrial school record, possibly in the case of those with a record of fine or probation, and probably not in the case of those with a jail record or with a penitentiary or reformatory record. The values of χ^2 and P appear at the foot of the columns in Table I. One must be cautious about comparing one of these groups with another, because they are based on different total numbers of cases. If the men with penitentiary or reformatory records had been as numerous as those with no previous criminal record it is quite possible that the value of χ^2 for the former group would have been as large as that for the latter group. χ^2 is not a measure of association; it is merely a measure which enables us to test a hypothesis as to the significance of discrepancies in a sample of the size observed. If the marginal frequencies keep their same proportion to the total, the value of χ^2 increases directly in proportion to the increase in the total.

The χ^2 method, as we have just seen, answers a question which is different from that which we were considering in the preceding section of the paper.[1] For some purposes, this question may be very interesting. The χ^2 method has another valuable property, in that it enables us to pool the results for each classification by previous criminal record and test our entire table at one stroke. Since the five values of χ^2 are independent of one another, we may add them and refer their sum to a table of χ^2 and P, which we enter with $5\times2=10$ degrees of freedom. The result, entered in Table I at the foot of the last column, shows that, taken as a whole, the discrepancies between observation and expectation are greater than can reasonably be accounted for by chance.

In computing χ^2 for prisoners with no previous criminal record, we performed, in a sense, a controlled experiment in that the group was presumably homogeneous in having no previous criminal record. Similarly, in computing χ^2 for any of the other classifications we controlled criminal record. By our method of pooling the results of separate controlled studies we have a final figure in which the factor of previous criminal record is still controlled or held constant, permitting

[1] Different in the sense that the χ^2 method tests the significance of the discrepancies, taken as a whole, between observation and expectation, in a particular *column*. The former procedure, which tested the sum of the discrepancies in a particular *row*, is inapplicable to a column because the sum of the differences between observed and theoretical frequencies in a column is necessarily zero. Hardly necessary to add, the distinction between row and column is made solely with reference to Table I. It implies no qualitative difference between rows and columns other than is arbitrarily imposed by the arrangement of the table.

us to interpret the likelihood of chance accounting for the *net* discrepancies among all violators classified according to punishment record.

It happens that the labor of computing χ^2 *in a* $2 \times t$ *table may be* shortened by taking advantage of the fact that χ^2, which, by the usual definition, $= \overset{t}{\underset{s=1}{S}} \frac{({}_1n_s - n_s p)^2}{n_s p} + \overset{t}{\underset{s=1}{S}} \frac{({}_2n_s - n_s q)^2}{n_s q}$, reduces to $\overset{t}{\underset{s=1}{S}} \frac{({}_1n_s - n_s p)^2}{n_s pq}$, where ${}_1n_s$ and ${}_2n_s$ are frequencies in sub-groups in the first and second columns, respectively, of the s'th row.[1] The components of χ^2 in any such table are evidently merely the squares of the values which we took earlier in our paper as normal deviates in testing the significance of the discrepancies between observed and expected violations in the individual cells. The same arithmetical procedure which leads to χ^2 may be used, therefore, in calculating the values needed in the Westergaard method as adapted by Woodbury and needed in testing[2] the significance of a sum of discrepancies by finding its ratio to the standard deviation $\sqrt{Sn_s p_s q_s}$.

A given component of χ^2, such as $\frac{({}_1n_s - n_s p)^2}{n_s pq}$, may, in fact be interpreted as a value of χ^2 with one degree of freedom.[3] This suggests a method of answering still another question in Table I. Consider the discrepancies along the first row, including all prisoners with no punishment record. Previously, we found by adding the number of observed violators and the number of expected violators, and dividing by

[1] Remembering that $q = 1 - p$ and ${}_2n_s = n_s - {}_1n_s$, we have

$$\chi^2 = \overset{t}{\underset{s=1}{S}} \frac{({}_1n_s - n_s p)^2}{n_s p} + \overset{t}{\underset{s=1}{S}} \frac{(n_s p - {}_1n_s)^2}{n_s(1-p)} = \overset{t}{\underset{s=1}{S}} \frac{({}_1n_s - n_s p)^2}{n_s}\left(\frac{1}{p} + \frac{1}{1-p}\right) = \overset{t}{\underset{s=1}{S}} \frac{({}_1n_s - n_s p)^2}{n_s pq}.$$

The writers' attention to this result was called by Dr. E. S. Pearson, University College, London, who also made other helpful suggestions regarding the application of the χ^2 test.

[2] The arithmetic may perhaps be reduced to its simplest form by again considering Table II, only the first column and the outside totals of which are now needed. The steps are as follows: (1) Calculate $p = 400/1883$, and $q = 1 - p$. (2) Place p in the calculating machine and multiply successively by 1284, 397, 202; entering the products in the table, just below the observed frequencies. These products represent the expected number of violators. (3) Subtract the expected numbers from the observed numbers. (4) Check steps (1), (2), and (3), by adding the differences; which should be zero, within the limits of rounding. (5) Place q in the calculating machine and multiply successively by the expected frequencies, giving the values of $n_s pq$; multiply also by the total number of violators, 405, thus checking the accuracy of the individual values of $n_s pq$ if q has been entered in the machine correctly. (6) Square the differences between observation and expectation and divide by the corresponding $n_s pq$. The only check on this step is division or repeating of the operation. (7) Find the square roots, which may be taken as a normal deviate if n and p are not too small. This procedure was followed in calculating the entries in Table I.

[3] Referring χ^2 to a table of P (χ^2) with one degree of freedom (the most complete table with one degree of freedom is found in Yule, *Introduction to the Theory of Statistics*, 7th edition, pp. 288-9) one will make exactly the same interpretation with respect to chance as in referring the square root χ to a table of the normal curve. The value of P in the table of P (χ^2) is equal to the sum of the probability of getting a value of χ greater than $+\chi$ and of the probability of getting a value of χ less than $-\chi$.

$\sqrt{Sn_sp_sq_s}$, that the difference between the two sums was too large to be considered due to chance. Let us suppose, for purposes of argument, that we had found that the difference between the two sums was very small as compared with $\sqrt{Sn_sp_sq_s}$. Then we would rightly say that the difference easily could be accounted for by chance. We still could hardly make the blanket statement that our five samples of prisoners with no punishment record were drawn by chance from a hypothetical population in which punishment record had no effect on violation rates. It might still be true that punishment record was a factor in the case of each individual sample of the five, but that it had opposite effects in one sample from its effects in other samples. A large positive difference between observed and expected violators in the group with no punishment record, for example, might be so nearly cancelled by a large negative difference in the group with a jail record that the sum of the differences would be negligible. Yet each difference, considered by itself, might be too large to be accounted for by chance. If we simply add the values of χ^2 for each group we can test whether such a simultaneous set of discrepancies as found in the five groups could be attributed to chance. Each of the five values of χ^2 is based on one degree of freedom; hence we refer their sum to a table of $P(\chi^2)$ with five degrees of freedom.[1] One should keep clearly in mind that the results of this test are likely to be different from the results of relating the sum of the differences to their standard deviation $\sqrt{Sn_sp_sq_s}$, because the two methods are testing *two entirely different hypotheses*.

The fact that two different hypotheses are available should be no more confusing in this case than in any other inquiry. Consider, for example, the question as to whether the mean of a given sample arose by chance from a population with a given mean and standard deviation. One can test this hypothesis, and it may be entirely sufficient for the purposes of a given inquiry. Or one can test another hypothesis, namely, that the frequencies in the class intervals of a given sample could have arisen by chance in sampling from a population with given frequencies in the corresponding class intervals. This, too, is a perfectly legitimate hypothesis, and may be answered in the negative when the former hypothesis is answered in the affirmative, or *vice versa*. (Indeed, these are only two out of many legitimate hypotheses which we might test.) The danger of loose thinking arises when one fails to formulate a hypothesis exactly and falls into the common error of saying, "The effect of this factor is or is not attributable to chance"

[1] See R. A. Fisher, *Statistical Method for Research Workers*, Chap. IV, especially Section 22.

instead of saying, "The effect of this factor, *as measured in such and such a way*, is or is not attributable to chance."

Which of the two different methods of analyzing the results in the first row of Table I is desirable, is entirely a matter of the purpose of the investigator. If his interest is primarily in the comparison of the difference between the sum of the observed and expected violators, namely, 405 and 470.89, it would seem that the logical treatment is to compare this difference with its standard deviation $\sqrt{Sn_s p_s q_s}$, or with its possibly sufficiently accurate approximation, $\sqrt{npq}$. If most of the differences observed in the five sub-groups are of the same algebraic sign, he may not feel any need to inquire further. If the differences between the sums are small and if there are striking differences with opposite algebraic signs in the sub-groups he may desire to *shift his attention from a consideration of the difference between the sums to a* consideration of the individual discrepancies. Then the χ^2 test, obtained by summing the individual values of χ^2 across a row, may be in order.

In fact, the difference between 405 and 470.89 in the first row of Table I is much too large to be attributed to chance and the individual differences between observed and expected violators are all negative. The answer as to the effect of punishment record, as measured by comparing 405–470.89 with $\sqrt{Sn_s p_s q_s}$, is therefore decisive. If this is decisive, it would seem irrelevant in the present inquiry whether the differences within the sub-groups of a given row, when considered individually and then pooled for purposes of summary by use of the χ^2 test, are attributable to chance or not. The pooled values of χ^2 are entered in each row of Table I. The value of χ^2 for those with no punishment record is significant; χ^2 for those with one or two punishments is possibly significant; χ^2 for those with three or more punishments is not significant and may be attributed to chance. In all cases, however, the values of the sum of the differences between observed and expected violators are significant, exceeding their standard deviation by more than two times.

In the present problem, the χ^2 method is mainly of value (1) in enabling us to appraise the effect of punishment record in violation rates for all parolees in each of the five individual classifications by previous criminal record; and (2) in enabling us to summarize the discrepancies between observed and expected violators over the entire table, by adding these five values of χ^2 and referring to a table of P (χ^2) with 10 degrees of freedom. These two problems differ from the main quest of the Westergaard-Woodbury procedure and yield supplementary information which should be of interest in many cases. The third use to

which the χ^2 method was put, in adding the values of χ^2 for each row, probably would have been of interest only if the difference between the sums of observed and expected violators in a given row were small.

To sum up, we have indicated the uses of two general procedures for testing for chance the discrepancies between observation and theory in a table constructed by the Westergaard method as adapted by Woodbury. In our example, we have seen that as a whole a record of punishment while in prison discriminated significantly between violators and non-violators of parole, making full allowance for the effect of previous criminal record; although the number of prisoners with a previous criminal record of jail sentence or of penitentiary sentence was not large enough to give us confidence that it discriminated significantly in these two groups.

The further question remains as to whether punishment record is merely a function of some other factor, such as type of crime for which committed to Pontiac, urban or rural background of the prisoner, etc. The method of expected cases enables us to analyze as many other factors as we wish, though the labor increases in geometric ratio with the number of factors. The 1,883 parolees with no previous criminal record may be sub-divided not only into three rows according to punishment record but also into, say, five columns according to type of crime for which sentenced. Expected violations in each new sub-group may be computed as before. Since there are five groups by previous criminal record the sum of our expected violators among those with no punishment record will be compounded of 25 entries. We can test significance of the difference between 405 and this sum by the same method as before, although many of the sub-groups will now be too sparsely populated to justify the reference to their individual differences to a table of the normal curve. We can use the χ^2 test for any sections of the table where it will answer a question of interest, provided we include no sub-groups with less than 2 or 3 expected violators. (Some would place the minimum limit at 5, although this seems unnecessarily conservative.)

Finally, it should be understood that the procedures illustrated by the writers are only a selection out of several possible approaches to the problem of testing significance. They were selected primarily because of their simplicity. It is hoped that this paper will encourage the further consideration of these and other approaches and the appraisal of their respective merits.

THE AMERICAN FAMILY INCOME AND PROSPERITY

By Louis Bader, *New York University*

The purpose of this paper is to invite attention to the importance of the family in our economic activity. It does this by suggesting a distribution of family income in the United States in 1932, making a comparison of that distribution with a distribution for 1928, and then by means of other data, indicates the effects of this change in family incomes on the economic activity of the country. The family is selected because it still is the principal consumption unit, and what industry, farm, forest, and mine are to produce depends, for the most part, on the wants of individuals as expressed through the family purse. There are, of course, many factors which are effective in directing consumption, but probably the most important is income. This paper examines the income and the relations between income and family expenditures and the effect of these expenditures on production, employment, prices, and profits.

In a recent estimate of income distribution in the United States for 1928, Dr. W. I. King [1] arrives at the following figures: an income [2] of $84,803,698,000 distributed among 46,704,965 personal recipients. He breaks this down into class intervals of $200 in size. If we summarize King's more detailed figures we get the distribution as shown in Table I.

TABLE I

NATIONAL INCOME AS DISTRIBUTED AMONG RECIPIENTS IN 1928

Income (dollars)	Number of persons	Total income (thousands of dollars)	Average income per person (dollars)
Under 1,000	10,014,000	7,463,600	745
1,000 to 2,000	*27,542,000*	*39,468,200*	*1,433*
2,000 to 3,000	6,630,000	15,484,300	2,335
3,000 to 5,000	1,397,000	5,210,000	3,730
5,000 and over	1,122,065	17,176,008	15,306

From this we can construct a cumulative per cent distribution as indicated in Table II.

These individual income recipients are not each the sole supporter of a family; consequently it becomes necessary to develop an estimated distribution of family incomes. Leven has done this for The Committee on the Cost of Medical Care based on King's 1928 income distribution, and a summarization of his findings is shown in Table III.

Taking the mid-point of each income range as the average for the

[1] *From unpublished data compiled by Dr. W. I. King.*

[2] Money and commodity income.

TABLE II

CUMULATIVE PER CENT DISTRIBUTION OF INCOME RECIPIENTS AND INCOMES IN GIVEN INCOME GROUPS

Upper limit of income group (dollars)	Cumulative percentages	
	Number of recipients	Income received
1,000	21.4	8.8
2,000	80.4	55.8
3,000	01.0	74.0
5,000	07.0	80.1
Indefinite	100.0	100.0

TABLE III

ESTIMATED DISTRIBUTION OF FAMILIES ACCORDING TO AMOUNT OF ANNUAL INCOME, 1028 *

1028 Income (dollars)	Number of families	Per cent	Cumulative per cent
All incomes	20,000,000	100.0	.....
Under 1,000	4,000,000	14.0	14.0
1,000 to 2,000	11,077,000	41.3	55.3
2,000 to 3,000	0,235,000	21.5	76.8
3,000 to 5,000	4,060,000	14.0	00.8
5,000 and over	2,008,000	0.2	100.0

* Estimated by Dr. Maurice Leven from Dr. Willford I. King's estimated distribution of individual income recipients and other data. The families are "census" families and include approximately 2,280,000 households of one person. In addition to the families distributed here there were in 1028, approximately 6,400,000 gainful workers outside the family units as designated by the census. *The Ability to Pay for Medical Care*, p. 11.

group and multiplying by the number of families in the group we get the total income for each group. This is shown on Table IV which indicates the family income in the United States as distributed by dollars.

TABLE IV

ESTIMATED FAMILY INCOME AS DISTRIBUTED BY DOLLARS IN 1028

Number of families	Total income of group (thousands of dollars)	Per cent	Cumulative per cent	Average family income (dollars)
20,000,000	84,803,008	100.0	.....	2,024
4,000,000	2,030,000	2.4	2.4	500
11,077,000	17,005,500	21.2	23.0	1,500
0,235,000	15,587,500	18.3	41.0	2,500
4,000,000	10,240,800	10.1	61.0	4,000
2,800,000	32,080,008	30.0	100.0	12,424

These are family incomes in a year regarded as one of the most prosperous in the history of the United States. Productive machinery generally was kept in active operation; employment was at better than average levels; real wages were at comparatively high levels and prices for most products were on a profitable basis. In a few years this was changed to a condition almost completely opposite. Meanwhile what

had happened to family incomes? Students of the national income suggested that for 1932 it was no more than half that of 1928. Should this actually be the case then our national money income in 1932 totalled about $42,401,849,000. This reduced total played havoc with the family income, for not only was the income cut in half, but, between 1928 and 1932 there was a substantial increase in the number of families. The census of 1930 reported 29,904,663 families [1] consisting of a total of 122,775,046 persons. Between the census of 1930 and the mid-year of 1932 it is estimated the population increased by 2,046,954 persons.[2] Since the census estimates private families as averaging 4.01 persons,[3] and making allowance for single, unattached persons, we may assume 30,400,000 families for 1932. Assuming also that these families are distributed as to income in the same degree as shown in Table III for 1928 incomes, we get Table V, showing estimated distribution of families according to annual income in 1932, before modification is made for the lower national income of 1932.

TABLE V

ESTIMATED DISTRIBUTION OF FAMILIES ACCORDING TO AMOUNT OF ANNUAL INCOME (1932)

1932 Income (dollars)	Number of families	Per cent	Cumulative per cent
All incomes	30,400,000	100.0	.....
Under 1,000	4,256,000	14.0	14.0
1,000 to 2,000	12,555,200	41.3	55.3
2,000 to 3,000	6,536,000	21.5	76.8
3,000 to 5,000	4,256,000	14.0	90.8
5,000 and over	2,796,800	9.2	100.0

But the national money income is only half in 1932 of that of 1928, so that if we assume the income is distributed in dollars in the same way as in 1928 as indicated in Table IV we get the dollar distribution as shown in Table VI. This would seem to be a fair assumption since all income groups have suffered, due to decreases in all forms of income.

These family incomes may in some cases seem very small but even if the total money income were to be equally distributed among all the families each one would average roughly only $1,400 for the year. Studies of income and wages suggest that incomes are most unevenly distributed in the United States,[4] and consequently no great stretch of the imagination is necessary to believe that family incomes in the disastrous year of 1932 were roughly as indicated above.

[1] *Statistical Abstract of the United States*, p. 42.

[2] *Ibid.*, p. 3.

[3] *Ibid.*, p. 42.

[4] King's estimated distribution of national income in Table I, Douglas, *Real Wages in the United States*, 1890–1926, 1930; and annual reports, United States Treasury Department, *Statistics of Income*.

As is to be expected when the national income is cut in half, many families are thrown into sharply lower income groups. In 1928 we had apparently a little over sixteen million families with annual incomes averaging $1,500 and less, and almost thirteen million families with yearly incomes averaging $2,500 and over. In 1932 the corresponding

TABLE VI

ESTIMATED FAMILY INCOMES AS DISTRIBUTED BY DOLLARS IN 1932*

Number of families	Total income of group (thousands of dollars)	Per cent	Cumulative per cent	Average family income (dollars)	
				Current	1928 †
30,400,000	42,401,840	100.0	.....	1,391	1,700
4,250,000	1,017,644	2.4	2.4	239	293
12,555,200	8,989,102	21.2	23.6	716	878
6,530,000	7,759,538	18.3	41.9	1,187	1,455
4,250,000	8,098,763	19.1	61.0	1,902	2,332
2,700,600	16,536,722	39.0	100.0	5,912	7,248

* Since data are not available to present an exact distribution of family income, this distribution is offered merely as a working hypothesis.

† Based on National Industrial Conference Board's Cost of Living Index, which showed a change between 1928 and 1932 from 100.4 to 77.7. Quoted in *Survey of Current Business*, February, 1933.

figures were more than twenty-three millions and one and one-quarter millions respectively, even after allowance is made for the increased purchasing power of the dollar. Business men and social workers alike, although for different reasons, are deeply interested in the question, "What happens when incomes are sharply reduced?" Obviously such a change would mean a drastic revision in type, quantity and quality of consumption, with resulting ill effects for business through decreased profits, and for the state through a possible lowering in the quality of its citizens, and smaller incomes subject to taxation.

The full significance of the relation between a sharp reduction in income and expenditures is not seen until one analyzes available family budget studies. Unfortunately family budget studies are not made regularly and on a sufficiently comprehensive scale, so that in this field also one must estimate considerably. There have been, however, enough isolated studies to indicate tendencies. A review of some of these studies will enable us to visualize better what probably happened between 1928 and 1932 with respect to consumer expenditures, and to suggest why the present depression has been so drastic and prolonged.

The major family budget studies in this country were those made by the Department of Labor covering American industrial workers' families in 1891, 1901 and 1919. The yearly family expenditures studied ranged from under $200 to $2,500 and over. These are summarized in Table VII.

The averages varied for the different incomes. The expenditures for food decreased sharply, ranging between 49.6 and 28.6 per cent; the expenditures for clothing and miscellaneous items increased materially, clothing ranging between 8.7 and 20.4 per cent; the miscellaneous

TABLE VII

SUMMARY OF OFFICIAL FAMILY BUDGET STUDIES*

Study income range (dollars)	Average expenditures percentage of total				
	Food	Clothing	Rent	Fuel and light	Miscellaneous
1891 Under 200 to 1,200	41.4	15.3	15.1	5.0	22.7
1901 Under 200 to 1,200	43.1	13.0	18.1	5.7	20.1
1919 Under 900 to 2,500	38.2	16.6	13.0	5.2	26.4

* Summarized from Table XLIII, Nystrom, *Economic Principles of Consumption*, p. 223.

expenditures ranging between 14.0 and 40.1 per cent; and the expenditures for fuel and light decreased, ranging between 8.1 and 4.1 per cent, as the total expenditures increased.

In between these studies many others [1] were made by sociologists for various interests, and these all show the same tendencies. Nearly all of them were of budgets of industrial urban workers, and of sub-normal families requiring relief. Since 1919 many other studies have been made, some of industrial workers, and others of professionals' families enjoying substantially larger incomes than those previously studied. Some of these are summarized in Table VIII.

It will be noticed in all of these studies that most families, as expenditures increase, spend considerably less of the total for food, and correspondingly more for miscellaneous items.[2] In this paper the miscellaneous expenditures cover everything other than food, clothing, and rent. In the few studies dealing with expenditures greater than $5,000 a year the expenditures for food decrease very sharply and miscellaneous expenditures increase just as sharply. For example in Peixotto's excellent study *Getting and Spending*,[3] food expenditures range between 9.1 and 18.1 per cent, and miscellaneous items between 52.1 and 71.2 per cent. When incomes decrease the reverse takes place. All the studies indicate that when incomes are low, say $1,200 and under, the expenditures for food range between 40 and 60 per cent; for housing between 12 and 24 per cent; and for clothing between 10 and 16 per cent, of all expenditures. These three items then account for between 62 and 100 per cent of all expenditures in the low income groups. The balance of the incomes is

[1] Berridge, Winslow, and Flynn, *Purchasing Power of the Consumer*, pp. 120–160.
[2] This was clearly shown by Ernest Engel as early as 1857. Quoted by Nystrom, *op. cit.*, p. 218.
[3] P. 133.

TABLE VIII

SELECTED STUDIES OF FAMILY BUDGETS MADE SINCE 1918 SHOWING PERCENTAGE OF EXPENDITURES FOR FOOD, CLOTHING, HOUSING, AND MISCELLANEOUS ITEMS

Study	Income (dollars)	Average and range expenditure percentage of total							
		Food	Range	Clothing	Range	Housing	Range	Miscel-laneous	Range
Farmers* 2,886 families	Under 600–3,000	41.2	54.4–30.7	14.7	11.6–16.4	12.5	12.5–10.9	31.6	21.5–42.0
Federal employees† 506 families	Under 1,200–3,600	32.6	40.0–27.0	11.6	10.0–14.0	19.6	24.0–16.0	30.0	25.3–34.4
Ford employees‡ 100 families	Average 1,711.87	32.3	....	12.2	....	22.6	....	32.9	....
Street car men§ 98 families	Under 1,000–3,000	38.0	59.9–15.0	11.2	8.1–22.8	17.9	36.7– 3.4	33.0	27.1–53.2
Professional group‖ 802 reports	Under 1,000–6,500	23.3	36.5–18.8	12.7	10.6–17.9	23.3	24.1–18.7	40.7	27.0–47.3
East Side New York¶ 252 families	Average 3,968	29.0	....	11.0	....	15.0	....	45.0	....
Minimum budgets** Laborer's family, 1926	2,010.72	32.3	....	16.0	....	22.8	....	28.9	....
Clerical workers, 1925	2,234.44	28.0	....	19.5	....	26.5	....	26.0	....
Suggested budgets	600–2,400	30.0	40.0–22.0	14.3	14.0–15.0	21.0	23.0–20.0	34.6	24.0–44.0

* U. S. Department of Agriculture, Bulletin No. 1466, *The Farmer's Standard of Living*, 1926.
† U. S. Department of Labor, *Cost of Living of Federal Employees in Five Cities*, 1929.
‡ International Labor Office, *An International Enquiry into Costs of Living*, 1931.
§ Cost of Living Studies IV. University of California Press. 1931.
‖ *Distribution of Expenditures and a Cost of Living Index for a Professional Group*, Ohio State University, 1932.
¶ Report of East Side Chamber of Commerce, *New York Times*, March 15, 1930.
** *A Family Budget*, Metropolitan Life Insurance Company.

used for fuel, light, medical attention, reading matter, carfares, entertainment, vacations, insurance, and luxuries such as candy, cigars, domestic household appliances, savings, and so on. It is apparent that in many cases nothing can be spent for these things and dependence is placed on charity, and in most cases the expenditures for the host of miscellaneous items will range between $100 and $200, which can take care only of the most necessary of the miscellaneous items like fuel, light, medical attention, carfares, and insurance. If the figures in Table VI are approximately correct then nearly all of the families in the United States are in the group sharply limited as to expenditures for miscellaneous items and we have the explanation of the drastic decline in business since 1929; families are not able to buy those products and services, the production of which gave us the prosperity of the era prior to 1929.

Again, if the figures in Table III are approximately correct we have the explanation of the prosperity of the era ending in 1929. Most families in this era averaged incomes which permitted of spending several times the sum available for miscellaneous items in 1932.

The devastating effects on business of the changes in family incomes between 1928 and 1932 are to be seen in production activities, employment, prices, and profits as shown in Tables IX and X.

TABLE IX

INDEXES OF PRODUCTION, EMPLOYMENT, AND WHOLESALE PRICES 1928 AND 1932*

(1923–1925=100)

Industries	Production index		Employment index		Wholesale price index	
	1928	1932	1928	1932	1928	1932
All industries	112	03	07.2	02.4	96.7	04.8
Manufactured foodstuffs	98	87	08.6	82.0	101.0	01.0†
Textiles	107	82	05.1	....	05.5	54.0
Anthracite coal	03	..	.....	....	84.3‡	70.3
Automobiles	110	35	108.8	....	......	.....
Iron and steel	110	31	05.4	50.0	93.4	.....
Lumber	01	26	88.1	36.8	03.7	.....
Cement	118	52	00.5	....	94.0	.....

* *Survey of Current Business*, Annual Supplement, 1932 and February, 1933.
† Not precisely comparable with manufactured food products.
‡ Fuel and lighting.

Foodstuffs and textiles declined comparatively little in production while the production of postponable, durable items suffered a very sharp curtailment, as one would expect from a study of family budgets. And *these changes had a profound effect on profits earned.* Sharp as were the changes in profits the necessities changed less, on the whole, than the postponable goods industries.

TABLE X

PROFITS EARNED IN 1928 AND 1932 BY CERTAIN SELECTED INDUSTRIES*

Industries	Profits earned† (thousands of dollars) (D) = deficit		Number of companies	
	1928	1932	1928	1932
Necessary goods				
Apparel	20,450	7,818 (D)	21	23
Cotton mills	9,563	9,165 (D)	30	33
Textile products miscellaneous	16,072	9,422 (D)	16	22
Drugs and sundries	55,695	27,701	18	14
Bakery	40,251	27,160	16	17
Food products miscellaneous	102,169	32,217	25	35
Meat packing	39,206	2,029 (D)	20	18
Coal mining	8,081	374	11	10
Postponable goods				
Amusements	38,136	11,346 (D)	13	12
Automobiles	395,005	7,331 (D)	23	12
Building materials	33,729	11,525 (D)	31	32
Electrical equipment	133,308	18,148 (D)	36	24
Household goods ‡	81,200	8,051	33	16
Iron and steel	224,392	127,191 (D)	43	33
Heating and plumbing	38,391	1,815 (D)	10	12

* Monthly Letter, National City Bank, issues March, 1930, and 1933.
† The figures here used may not be comparable, their use is merely for illustrative purposes.
‡ In 1928 this is listed as Household Supplies consequently this item may belong in the group of necessary goods.

Can family incomes be brought back to at least the size or purchasing power of 1928? Unless they can the industries producing luxuries and durable goods which share in the dollars expended for the miscellaneous items face, in the future, very lean business, and price rather than advertised quality will continue to rule the roost. Even the incomes of the era prior to 1930 were for most families nothing to brag about. Then nearly 23,000,000 families had incomes of $3,000 a year or less. What all families can use in the way of incomes, with a little training, is indicated by the annual expenditures of our so-called wealthy families.

There has come to be a general recognition among intelligent persons that this country will not again know prosperity unless the purchasing power of our mass of people is increased very materially. The era prior to 1930 demonstrated that we can produce sufficient goods and services to make possible high real incomes for all those willing to work for them. The trouble has been, in large measure, it would seem, a failure to develop and make known a method of distributing wealth that keeps pace with the greatly increased production of which we have become capable. As soon as there is general knowledge of such a method it will, probably, be put into action, not only because the mass of people presses for it, but because many owners of wealth are likely to favor it; we prefer prosperity to depression. There are no natural laws or conditions governing income distribution; it is a man-made division of our

income subject to change whenever man so wishes. The best of our wealthy persons and business men realize they are only trustees for the common good of the wealth which they possess. They realize too, that the effect of low family incomes is just as devastating to business men and the owners of wealth from which income is expected as it is to the bulk of our families. One can believe that many think it is better to share the income more equitably voluntarily than to have this forced unenjoyable sharing and general curtailment of income every few years; that such voluntary sharing might well lead to a steady yearly increase in national and individual incomes.

We can see the effects of changed family incomes on business, but perhaps not so readily on the state. It is not the purpose of this article to point this out, although it might be suggested, in passing, that the lowered incomes have resulted in an enlarged charity list, and this ordinarily, when long continued, breaks down individual morale, and may mean having added materially to our permanent poor relief recipients, which is not particularly good for us.

One can hardly believe that either business men in large numbers, or society in general desire to see incomes such as those of 1932, and one can easily believe that if such incomes long continue, one day an upheaval will occur accompanied by disaster and chaos, which will be devastating to our civilization. Indeed, the general acquiescence in the criticism of capitalism and the more widespread acceptance of the implications inherent in the terms socialism and communism, suggest we may not be so very far away from drastic changes in the accepted institutions of our economic system.

SECONDARY CURVES AS A MEASURE OF THE LAG OR PHASE DIFFERENCE BETWEEN TWO PRIMARY CURVES

By R. von Huhn

PART I. A COMPARISON BETWEEN TYPICAL PRIMARY CURVES AND THEIR RESPECTIVE SECONDARY CURVES

Whenever we have two or more numerical series which show the characteristics of periodic phenomena such as the propagation of sound waves, we frequently find that two points of the same y-magnitude are displaced by a certain x-magnitude on the time axis or, to put it the other way, it occurs that a certain point P_1 of a curve, for example, will be so many time units in advance of a point P_2 of another curve, or vice versa P_1 may follow point P_2. The physicist calls this phenomenon the "phase difference" while the economist terms it the lag. Periodic economic series, however, do not move with the mathematical precision observed in the field of physics and therefore the lag between two series cannot be determined as conveniently and directly as in the case of harmonic amplitudes.

The approach, however, can be made indirectly by means of cumulative curves, which have among other analytic qualities, the unique feature of rectification of primary data, that is to say the secondary curve brings a particular primary curve into a shape which enables the observer to make, through visual conclusions, numerical ones.

We may now proceed with the study of the effect which the cumulative operation has on the non-cumulative data by a comparison between typical primary curves and their respective secondary or cumulative curves. We shall find that each type of primary curve is accompanied by a characteristic secondary curve. In Table I there are shown six types of primary curves P together with their respective secondary curves S. These types of curves are frequently observed when plotting economic series. For better comparison the data for both columns P and S have been reduced to a percentage basis and plotted as shown in Figure I. Now before inspecting these curves we must recall that the line connecting point O with the last y-unit $(x=12)$ $(y=100)$ represents the average accumulation of the whole period $O-12$, and with reference to this line the various positions of each point on the secondary curve can be measured.

Case 1. The primary curve is bell-shaped [1] and the secondary curve

[1] The term bell-shaped is not used here in the classical sense and, consequently, does not refer to the probability curve.

is S-shaped, a characteristic of all bell-shaped curves, having been converted into secondary ones.

Starting from O the cumulative rate of increase of the curve falls constantly below the average cumulative rate of increase of the whole period, until at the sixth time unit the cumulative rate of increase of the curve is identical with the average cumulative increase for the whole period at that point. Beyond this point the cumulative rate of the secondary curve is constantly higher than the average cumulative increase and finally at $(x=12)$ $(y=100)$ both rates are the same.

Case 2. The primary curve is U-shaped and the secondary curve takes the reversed aspect of Case 1.

Case 3. The primary curve is asymmetrically bell-shaped, the secondary curve takes the shape of a distorted S. In this case the cumulative rate of increase of the secondary curve deviates negatively from the average cumulative rate of increase for a short time and after reaching point 1.5 of the time axis the cumulative rate of the secondary curve exceeds the average cumulative rate constantly and finally at $x=12$ both rates are the same.

Case 4. The primary curve is asymmetrical bell-shaped and its skewness negative. The secondary curve takes the reversed aspect of Case 3.

Case 5. The primary curve is M-shaped and represents a combination of two bell-shaped curves. We observe two characteristic S-shapes in the secondary curve. Closer examination reveals that the first part of the primary curve is similar to Case 3 and the second part of the primary curve similar to Case 4. The secondary curve shows clearly the resemblance to the secondary curve of Case 3 for the first part up to A and from there on the resemblance to the secondary curve of Case 4 up to B.

Case 6. The primary curve is W-shaped and therefore the reversal of the M-shaped curve and, consequently, the secondary curve takes the reversed aspect of Case 6.

PART II. ELEMENTARY CHARACTERISTICS OF A SECONDARY CURVE

In Part I we have shown a comparison between non-cumulative and cumulative data of six typical curves by means of general graphic presentation. Before proceeding further in the analysis it will be helpful to consider the relationship of two primary curves P_1 and P_2 as shown in Figure II. From inspection it will be noted that the curve P_1 reaches a maximum and declines thereafter, whereas P_2 also reaches a maximum, but somewhat later. It is evident that the two curves have a degree of displacement or lag with respect to each other, but

FIGURE 1

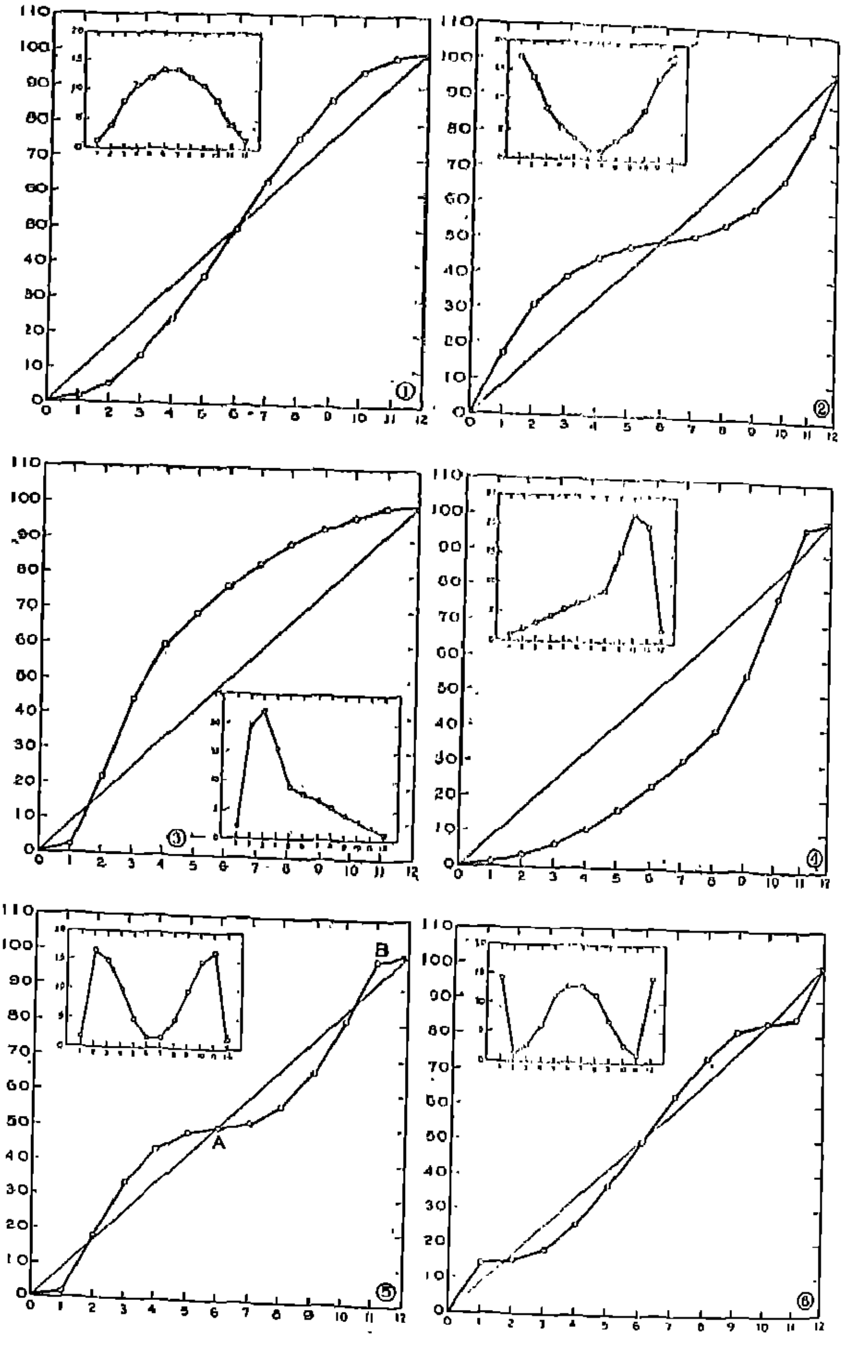


Figure II gives little information as to the magnitude of the lag or phase difference.

We have noted before that the secondary or cumulative operation consists in taking various y-magnitudes of the primary curve (y_{I}; y_{II}; y_{III}; etc.) which are plotted with respect to time beginning with the

TABLE I

X	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
	P	*S*	*P*	*S*	*P*	*S*	*P*	*S*	*P*	*S*	*P*	*S*
1	10	10	100	100	10	10	5	5	10	10	100	100
2	30	40	80	180	90	100	10	15	100	110	10	110
3	60	100	50	230	100	200	15	30	90	200	20	130
4	80	180	30	260	70	270	20	50	60	260	50	180
5	90	270	20	280	40	310	25	75	30	290	80	260
6	100	370	10	290	35	345	30	105	10	300	90	350
7	100	470	10	300	30	375	35	140	10	310	90	440
8	90	560	20	320	25	400	40	180	30	340	80	520
9	80	640	30	350	20	420	70	250	60	400	50	570
10	60	700	50	400	15	435	100	350	90	490	20	590
11	30	730	80	480	10	445	90	440	100	590	10	600
12	10	740	100	580	5	450	10	450	10	600	100	700

TABLE IA

X	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
	P	*S*	*P*	*S*	*P*	*S*	*P*	*S*	*P*	*S*	*P*	*S*
1	1.35	1.35	17.24	17.24	2.22	2.22	1.11	1.11	1.66	1.66	14.29	14.29
2	4.05	5.40	13.79	31.03	19.99	22.21	2.22	3.33	16.66	18.32	1.43	15.72
3	8.11	13.51	8.62	39.65	22.22	44.43	3.33	6.66	14.99	33.31	2.85	18.57
4	10.81	24.32	5.17	44.82	15.55	59.98	4.44	11.10	9.99	43.30	7.14	25.71
5	12.16	36.48	3.45	48.27	8.88	68.86	5.55	16.65	4.99	48.29	11.43	37.14
6	13.51	49.99	1.72	49.99	7.77	76.63	6.66	23.31	1.66	49.95	12.86	50.00
7	13.51	63.50	1.72	51.71	6.66	83.29	7.77	31.08	1.66	51.61	12.86	62.86
8	12.16	75.66	3.45	55.16	5.55	88.84	8.88	39.96	4.99	56.60	11.43	74.29
9	10.81	86.47	5.17	60.33	4.44	93.28	15.55	55.51	9.99	66.59	7.14	81.43
10	8.11	94.58	8.62	68.95	3.33	96.61	22.22	77.73	14.99	81.58	2.85	84.28
11	4.05	98.63	13.79	82.74	2.22	98.83	19.99	97.72	16.66	98.24	1.43	85.71
12	1.35	99.98	17.24	99.98	1.11	99.94	2.22	99.94	1.66	99.90	14.29	100.00

first one and adding to it the next one in sequence, then taking a subtotal and so on until the last value of the series has been reached. Expressed in symbols this would mean:

$y_{\mathrm{I}} = y_1 = P_1 =$ First point on the secondary curve

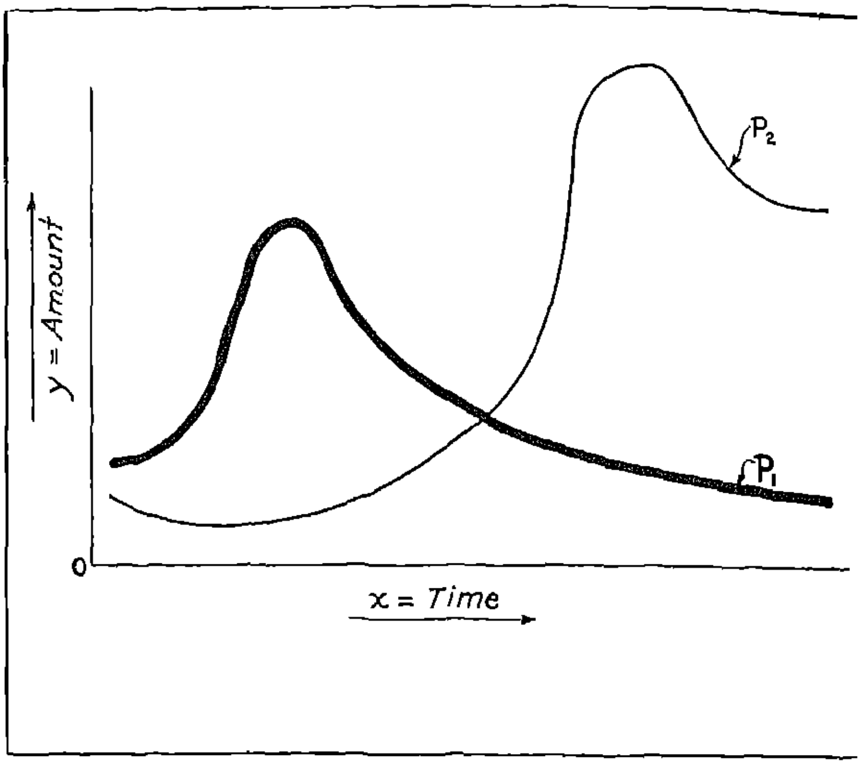
$y_{\mathrm{I}} + y_{\mathrm{II}} = y_2 = P_2 =$ Second point on the secondary curve

$y_{\mathrm{I}} + y_{\mathrm{II}} + y_{\mathrm{III}} = y_3 = P_3 =$ Third point on the secondary curve

Hence, P_1; P_2; P_3 represent cumulative totals up to a given point on the secondary curve Figure III, hence,

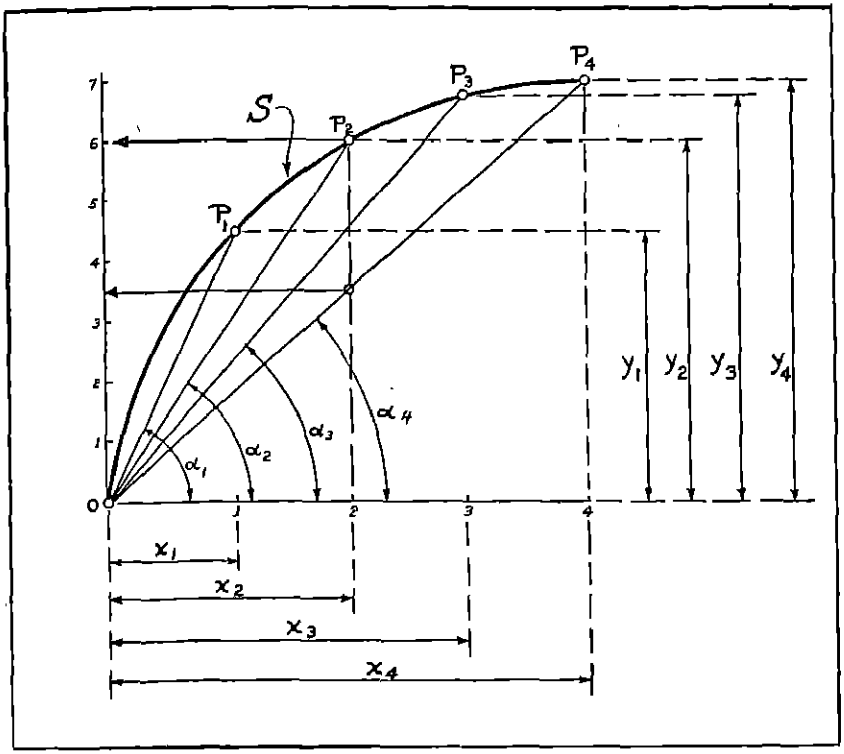
$$\frac{y_1}{x_1};\ \frac{y_2}{x_2};\ \frac{y_3}{x_3}$$

FIGURE II



represent cumulative average rates of increase at points P_1; P_2; P_3, respectively. At this point it will be helpful to consider by means of a simple example the mathematical characteristics of the cumulative method. Let us assume that curve S in Figure III represents a secondary curve and that P_1; P_2; P_3 and P_4 represent points on the curve for x_1; x_2; x_3 and x_4, respectively. If we connect point O successively with point P_1; P_2; P_3 and P_4, it is evident that for each of these points the average rate of increase varies according to the magnitude of the angles α_1; α_2; α_3 and α_4 and as the slopes of these angles decrease the various cumulative rates measured at the respective points on curve S also decrease. It is furthermore evident that the average rate for the total period $x_4=4$, is $7\div4=1.75$ which is equivalent to the tangent function of α_4 and from this it follows that for the remaining points the other angles α_1; α_2; α_3 are greater, thereby indicating a greater average increase for these particular points. Consequently, if the other average rates for various points of the curve S were greater than the final

FIGURE III



one represented by α_4 it is evident that the actual increases must have become smaller in order to reach eventually point P_4. This can be verified from Figure III. For example, at point $P_2(x_2)$, the line $\overline{OP_2}$ representing the cumulative average rate for P_2 at $x=2$ has reached point 6 on the vertical scale whereas the average rate for the whole period at $x=2$ has reached 3.4 units. As the curve advances to point P_3 the difference between these two magnitudes becomes smaller until in P_4 it becomes zero.

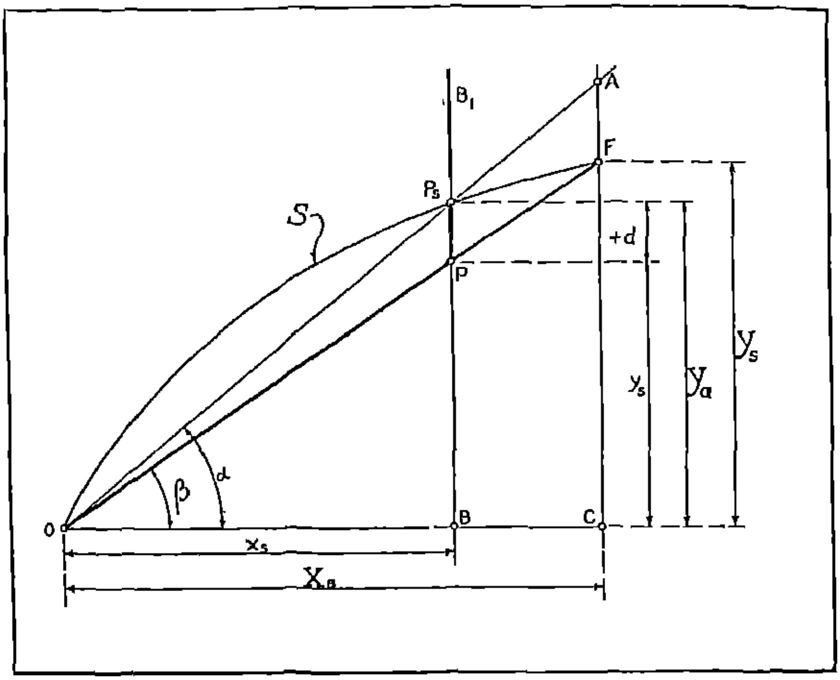
PART III. THE CUMULATIVE VERTICAL DISPLACEMENT FOR A GIVEN POINT P_s ON A CUMULATIVE CURVE AS COMPARED WITH THE AVERAGE VERTICAL DISPLACEMENT FOR THE WHOLE PERIOD

In Chart IV, S represents a cumulative curve and P_s represents a point on the curve at the arbitrary time unit x_s on the time axis, the vertical line $\overline{B_1B}$ representing a section through the time axis. Now the slope of the line $\overline{OF}$ is proportional to the average cumulative rate

for the whole period X_s which equals tangent β, on the other hand the slope of the line $\overline{OP_s}$ represents the average cumulative increase of the curve S up to the given point P_s, which equals tangent α. If we use the line $\overline{OF}$ as a base for measuring the respective deviations of curve S from $\overline{OF}$ we observe that at the intersection $\overline{BB_1}$, $\overline{P_sP}$ equals d which represents the positive deviation of S from the line $\overline{OF}$ at the given intersection BB_1 and therefore it follows:

P_s in precession[1] of P

FIGURE IV



$\angle\beta$ smaller than $\angle\alpha$

y_s smaller than Y_a

$\overline{P_sP} = d$ (positive)

$\overline{CA} : X_s = Y_a : x_s$

therefore:
$$Y_a = \frac{\overline{CA} . x_s}{X_s}$$

[1] The terms "precession" or "succession" in the case of Figures IV and V refer to the *vertical* excess or deficiency $(\overline{P_sP}) = \pm d$ of the actual accumulation (S-curve) at a given time element, any x_s, as measured from the line $(\overline{OF})$, which represents the average accumulation for the whole period. The terms therefore relate to the difference $(\overline{P_sP})$ between actual accumulation and average accumulation for the same time element x_s.

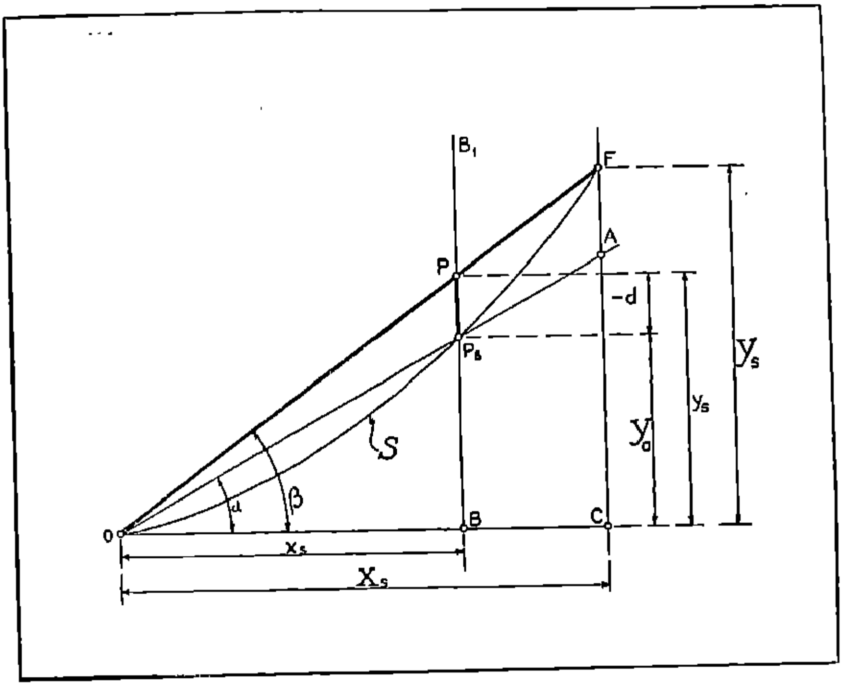
furthermore: $(Y_a - y_s) = d$ (d is positive with respect to OF)

hence,
$$+d = \frac{\overline{CA}.x_s}{X_s} - y_s$$

In Figure V we observe that at the intersection $\overline{B_1B}$ the point P_s on the curve S deviates from $\overline{OF}$ negatively by the linear amount $\overline{PP_s} = -d$ and therefore it follows:

P_s in succession of P
$\angle\beta$ greater than $\angle\alpha$
y_s greater than Y_a
$\overline{P_sP} = d =$ negative
$\overline{CA}: X_s = Y_a : x_s$

FIGURE V



therefore:
$$Y_a = \frac{\overline{CA}.x_s}{X_s}$$

furthermore: $(y_s - Y_a) = d$ (d is negative with respect to OF)

hence,
$$-d = y_s - \frac{\overline{CA}.x_s}{X_s}$$

Example (*I*) $\angle\beta$ smaller than $\angle\alpha$; d positive
given: $y_s=14$; $\overline{CA}=69$; $X_s=100$; $x_s=40$

$$d=\frac{\overline{CA}.x_s}{X_s}-y_s=\frac{69\times 40}{100}-14=27.60-14$$

$d=13.60$ (positive)

Example (*II*) $\angle\beta$ greater than $\angle\alpha$; d negative
given: $y_s=65$; $\overline{CA}=69$; $X_s=100$; $x_s=71$

$$d=y_s-\frac{\overline{CA}.x_s}{X_s}=65-\frac{69\times 71}{100}=65-48.99$$

$d=16.01$ (negative)

Trigonometric Equations for $+d$ and $-d$

(*a*) *Case No. 1* $\angle\beta$ smaller than $\angle\alpha$

$$\text{tang } \alpha=\frac{Y_a}{x_s}$$

$$\text{tang } \beta=\frac{y_s}{x_s}$$

it follows therefore:

$$Y_a=(\text{tang } \alpha.x_s)$$
$$y_s=(\text{tang } \beta.x_s)$$

furthermore:

$$d=(Y_a-y_s)=(\text{tang } \alpha.x_s)-(\text{tang } \beta.x_s)$$
$$d \text{ (positive)}=x_s\ (\text{tang } \alpha-\text{tang } \beta)$$

(*b*) *Case No. 2* $\angle\beta$ greater than $\angle\alpha$

$$\text{tang } \alpha=\frac{Y_a}{x_s}$$

$$\text{tang } \beta=\frac{y_s}{x_s}$$

it follows therefore:

$$y_s=(\text{tang } \beta.x_s)$$
$$Y_a=(\text{tang } \alpha.x_s)$$

furthermore:

$$d=(y_s-Y_a)=(\text{tang } \beta.x_s)-(\text{tang } \alpha.x_s)$$
$$d \text{ (negative)}=x_s\ (\text{tang } \beta-\text{tang } \alpha)$$

PART IV. THE CUMULATIVE HORIZONTAL DISPLACEMENT FOR A GIVEN POINT P_s ON A CUMULATIVE CURVE S AS COMPARED WITH THE AVERAGE CUMULATIVE DISPLACEMENT AT THIS POINT

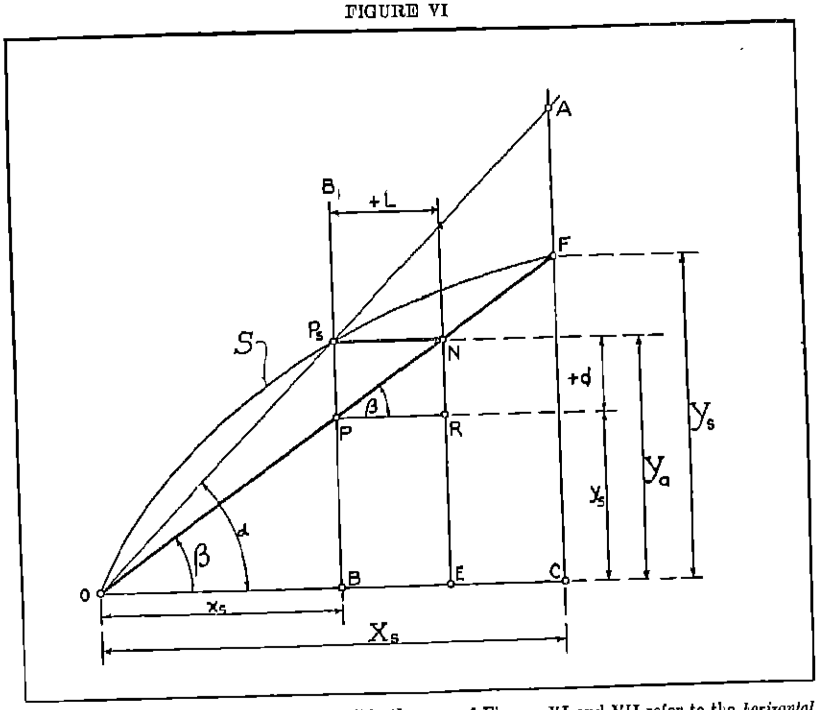
In Figure VI, S represents a cumulative curve and P_s a given point on the curve at the arbitrary time unit x_s on the time axis, the vertical line $\overline{B_1B}$ representing a section through the time axis. The slopes of $\overline{OF}$ and $\overline{OA}$ are proportionate to the tangents of angle β and α respectively. Now a horizontal line put through point P_s parallel to the x-axis intersects $\overline{OF}$ in N and consequently it follows:

P_s in precession [1] of P

$\angle\beta$ smaller than $\angle\alpha$
y_s = smaller than Y_a
$\overline{P_sP} = d$ (positive)

$$\text{tang } \alpha = \frac{Y_a}{x_s}$$

FIGURE VI



[1] The terms "precession" or "succession" in the case of Figures VI and VII refer to the *horizontal* excess or deficiency $(\overline{P_sN}) = \mp L$ as measured by any line parallel to the time axis, which intersects the S-curve and the line $(\overline{OF})$ respectively. The terms therefore relate to the difference $(\overline{P_sN})$ between the actual time x_s and the average time $\overline{OE}$ needed for the same accumulation namely, $\overline{BP_s}$ and $\overline{EN}$ respectively.

$$\text{tang } \beta = \frac{y_s}{x_s}$$

$$(Y_a - y_s) = \overline{P_sP} = d$$

$$\text{tang } \beta = \frac{d}{P_sN}$$

$$\overline{P_sN} = L = \frac{d}{\text{tang } \beta}$$

$$L = \overline{P_sN} = \frac{Y_a - y_s}{\frac{y_s}{x_s}}$$

$$L = \frac{(Y_a - y_s)}{y_s} . x_s$$

$$L = (Y_a - y_s).\text{cotg } \beta \text{ or } L = x_s\left(\frac{\text{tang } \alpha}{\text{tang } \beta} - 1\right)$$

Comparison is made between the average rate of the point P_s ($\angle\alpha$) on curve S at the time element x_s (intersection $\overline{B_1B}$) and the average cumulative rate of point P_s ($\angle\beta$) which is represented by P. If P_s had moved at the average constant rate according to the slope of angle β it would have reached the magnitude of $\overline{P_sB} = Y_a$ later to the extent of $\overline{P_sN} = L$ and therefore the length of L in the diagram equals the amount of time which P_s moves in precession of its own cumulative rate for the whole period at the intersection $\overline{B_1B}$.

In Figure VII, S represents again a cumulative curve and P_s a point on the curve as shown in Figure VI, the only difference being that in this case point P_s moves in sequence as compared with point N and consequently it follows:

P_s in sequence of P
$\angle\beta$ greater than $\angle\alpha$
y_s greater than Y_a
$\overline{P_sP} = d$ (negative)

$$\text{tang } \alpha = \frac{Y_a}{x_s}$$

$$\text{tang } \beta = \frac{y_s}{x_s}$$

$$(y_s - Y_a) = \overline{PP_s} = d$$

$$\text{tang } \beta = \frac{d}{NP_s}$$

$$\overline{NP}_s = L = \frac{d}{\text{tang } \beta}$$

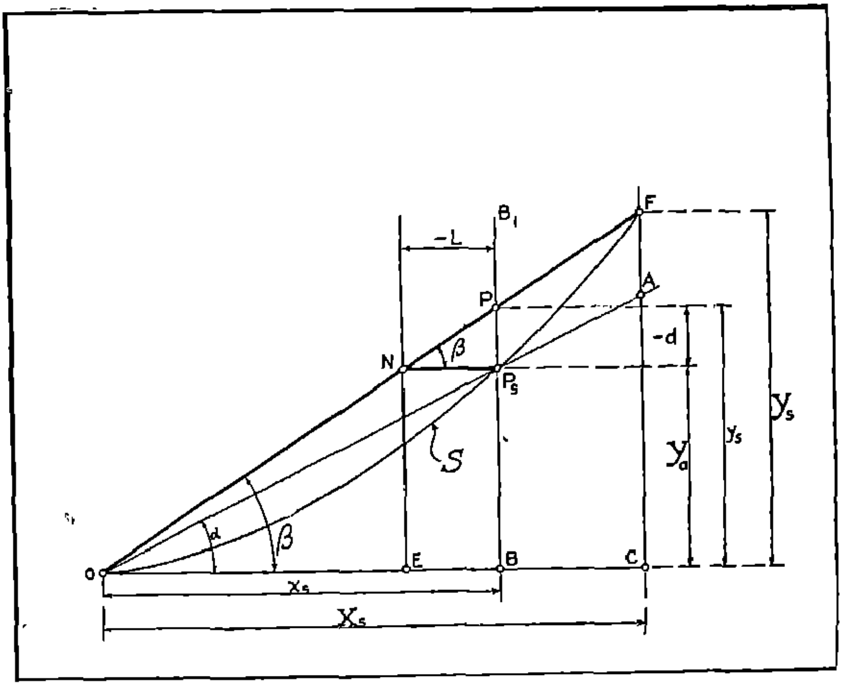
$$L = \overline{NP}_s = \frac{y_s - Y_a}{\frac{y_s}{x_s}}$$

$$L = \frac{(y_s - Y_a).x_s}{y_s}$$

$$L = (y_s - Y_a)\text{cotg } \beta \text{ or } L = x_s\left(1 - \frac{\text{tang } \alpha}{\text{tang } \beta}\right)$$

Comparison is made between the average rate of a point P_s ($\angle\alpha$) on curve S at the time element x_s at intersection $\overline{B_1B}$ and the average cumulative rate of point P_s($\angle\beta$) which is represented by P at the intersection B_1B. If point P_s had moved at the average constant rate proportional to the slope of $\angle\beta$ it would have reached the magnitude of $\overline{P_sB} = Y_a$ earlier to the extent of $\overline{P_sN} = L$ and therefore L equals the amount of time which P_s moves in succession of its own cumulative rate for the whole period at the intersection $\overline{B_1B}$ at x_s.

FIGURE VII



From the discussion it follows that we are able to compute the lag of a curve with respect to its own average rate for a given point P_s on the curve when x_s, $\angle\alpha$ and $\angle\beta$ are given.

Case 1: d is positive; $\overline{P_sN} = L$
therefore

$$L = x_s\left(\frac{\text{tang }\alpha}{\text{tang }\beta} - 1\right)$$

Example: $x_s = 49$ units; $\alpha = 44°\ 40'$; $\beta = 34°\ 20'$
tang $\alpha = .988$; tang $\beta = .683$

Substituted in above formula we obtain:

$$L = 49(1.446 - 1)$$
$$L = 22.83 \text{ time units } (P_s \text{ in precession})$$

Case 2: d is negative; $\overline{P_sN} = L$
therefore

$$L = x_s\left(1 - \frac{\text{tang }\alpha}{\text{tang }\beta}\right)$$

Example: $x_s = 78$ units; $\alpha = 26°\ 35'$; $\beta = 33°\ 10'$
tang $\alpha = .500$; tang $\beta = .653$

Substituted in above formula we obtain:

$$L = 78(1 - .764)$$
$$L = 18.41 \text{ time units } (P_s \text{ in succession})$$

PART V. THE COMPUTATION OF THE LAG BETWEEN TWO SECONDARY CURVES

Now in order to obtain a measure of the lag between two curves we shall find it convenient to express the various subtotals of each secondary curve as percentages of their respective totals, similar to the cumulative frequencies necessary to compute an ogive. Consequently the totals of both curves will equal 100 per cent and the connecting line between zero and the 100 per cent point represents the average per cent accumulation. Here it is well to point out that there is no absolute measure for the lag between two irregular curves because the magnitude of the lag depends upon the selection of the point of reference and therefore we must assume this reference or base at the outset. In the following we shall measure the lag relative to the following references: (1) the lag of two curves computed in relation to the average per cent line, (2) the lag computed in relation of one curve to another, (3) the lag computed on the basis of a given percentage accumulation.

We shall find that each of these methods will yield a different type of lag and the three above mentioned ones do not exhaust other possibilities. Furthermore, it will be convenient to plot the various curves and determine the various phase differences graphically.

Case 1

In Figure VIII there are shown the secondary curves Nos. 1 and 3 converted to a per cent basis (see Figure I). The arbitrary intersection $y-y$ on the time axis x, intersects the average percentage line $\overline{OH}$ at C, therefore the distance $\overline{AC}$ represents the magnitude of the time element which curve No. 3 runs in precession of the average per cent line at the eighth time unit and consequently, $\overline{BC}$ represents the time units which curve No. 1 runs in precession of the average per cent line $\overline{OH}$ at the same intersection.

In Figure IX these values have been plotted accordingly. We observe that part of the time both curves lag behind the constant rate line, curve No. 3 crosses the line at K overtaking at this point its own average rate and curve No. 1 later at point M, hereafter both curves run in precession of their respective constant rates. Figure IX can be interpreted that at the intersection $y-y$ at point 8 on the x-axis, curve No. 3 has reached point A, 3.3 time-units (measured from graph) sooner than it would have reached the same magnitude (point C on line $\overline{OH}$) had it progressed at the constant rate, and in the case of curve No. 1 point B was reached .8 time-units sooner respectively.

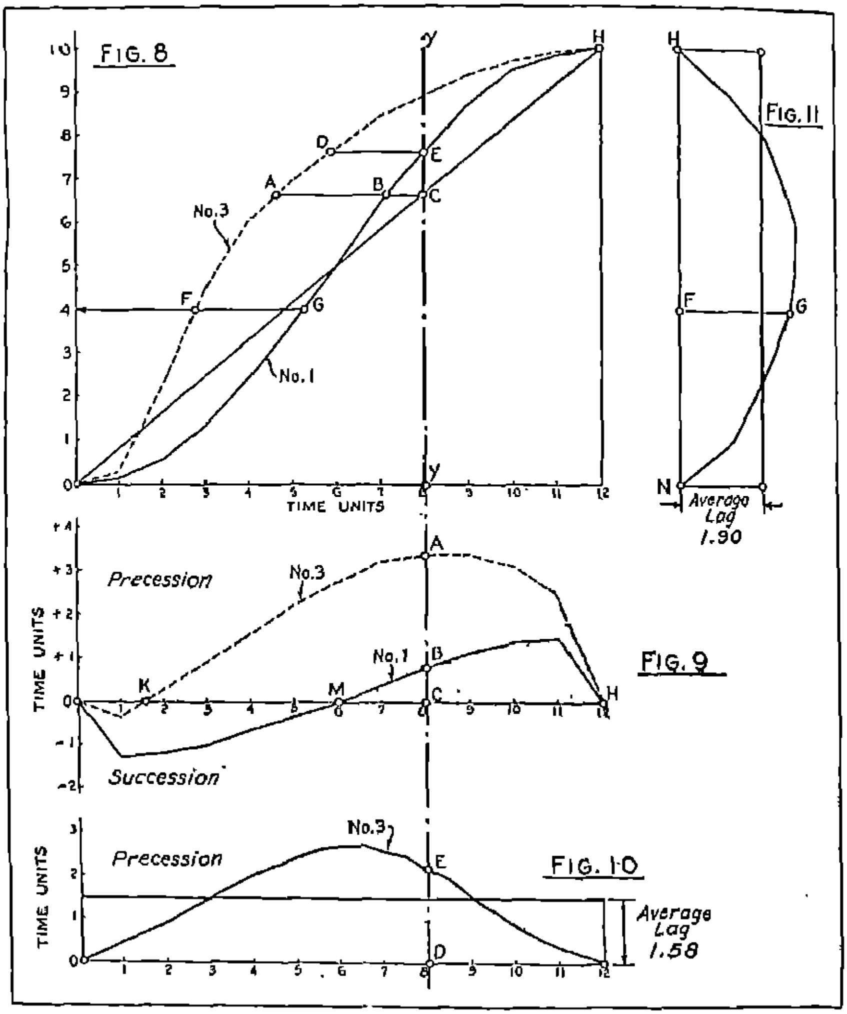
Case 2

Again in Figure VIII measurements are made between curve Nos. 3 and 1, using the latter one as reference. The vertical line $y-y$ at point 8 on the time axis intersects curve No. 1 at E. Now if a line is drawn through E parallel to the x-axis it intersects curve No. 3 in D. The distance $\overline{ED}$ represents a measure of the lag between curves No. 3 and 1. In Figure X these magnitudes have been plotted accordingly and show that curve No. 3 is constantly in precession of curve No. 1 when measured from curve No. 1 as reference line.

Case 3

When using this measure of displacement as shown in Figures VIII and XI the lag is measured in terms of percentage accumulation, that is to say, for example, that when each curve has reached 40 per cent of its own "performance" the relative displacement of curve No. 3 with respect to curve No. 1 is represented by the line $\overline{FG}=2.5$ time units (measured from graph) and represents the amount of precession, which curve No. 3 has as compared with curve No. 1 at 40 per cent of their respective accumulation.

FIGURES VIII, IX, X AND XI



PART VI. THE AVERAGE LAG

In the preceding paragraphs we have measured the relative lag between two curves at a given section of the time axis x. We now come to the measurement of the average lag for the total period. For this purpose we shall find Case 2 and 3 most suitable. It is only necessary to compute with the aid of a planimeter [1] the area between curve No.

[1] In case a planimeter is not available there are two methods by which an area can be computed without it. In case of the first method it is only necessary to plot the respective curves on millimeter paper and carefully cut out that part of the area which is to be computed, to determine its weight and to compare

3 and No. 1 in Figure VIII. This area measures approximately 19 square units. If we divide 19 square units by the base line 12 linear units in Figure X, we obtain the average lag 1.58 time units, and dividing 19 square units by 10 in the case of Figure XI, we obtain the average lag 1.9 time units. In the first case this means that the amount of succession of curve 3 as compared with curve 1 amounted to 1.58 time units and in the second case the lag of 1.9 time units must be interpreted to mean that on the average for equal percentages of performance of the two curves, curve No. 3 lagged 1.9 time units as compared with No. 1.

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it in turn with the weight of a known area of the same stock of paper. A chemical balance can be used to advantage.

The second method represents an approximation. The S-values in Table Ia are added for curves No. 1 and 3 respectively and the total subtracted from each other. In the above example we obtain 835.12 − 640.87 = 18.52 square units. The planimeter measures this area to be 19.00 square units and therefore the error amounts to about 2.5 per cent.

NOTES

ADJUSTING FOR THE CHANGING DATE OF EASTER IN ECONOMIC SERIES

By Jeanette Homan, *Western Electric Company*

In comparing the statistics for any month with those for the previous month, it is customary for the statistician to adjust the data for seasonal variation. In comparing with the corresponding month of the previous year, however, usually no such adjustment is needed. In several series of data followed currently by economists and statisticians, however, the occurrence of Easter has a direct effect upon the results for the months of March and April. In these series, therefore, to make a correct year-to-year comparison, the data should be adjusted for the effect of the different dates on which Easter occurs in the two years. For example, the daily average chain store sales in March, 1933, was 20 per cent smaller than in March, 1932. In 1932, however, Easter occurred on March 27th, so that the results for the month of March, 1932, contained the full effect of Easter purchasing. In 1933, Easter came on April 16th. If we adjust the sales figures for the effect of the different date of Easter, we find that the level of March, 1933, sales was only 11 per cent under March, 1932.[1]

In attempting to compute the effect of Easter upon series of data, we are confronted with the fact that most consistent series do not cover a long enough range of years to afford many instances in which Easter occurs on the same date. Some headway can be made, however, by working with the trend of the effect of the changes from the earliest to the latest date on which Easter may fall. By plotting a curve running from March 27th to April 20th, the usual range of the Easter dates, it is possible to find a trend which will represent the effect of these changing dates on the series studied. This can be further refined by being tied in with a constant, as will be illustrated in this study.

An analysis of the series for chain store sales explains and illustrates a method which seems both simple and effective for adjusting for Easter in the index of seasonal variation. The basic data used in this study are the monthly totals of sales of the four chain stores: F. W. Woolworth, S. S. Kresge, McCrory Stores Corporation, and S. H. Kress and Company, from 1919 to date, as given in the *Survey of*

[1] The writer recognizes that the idea of adjusting for the date of Easter is not new. The December, 1927, issue of this Journal carried a note on the Federal Reserve Board's Easter adjustment for department store sales. It is surprising to note, however, that in computing their year-to-year percentages for March and April, no Easter adjustment is used.

Current Business. The first step in the analysis is to adjust for the changing number of working days in the different months, by dividing each monthly total by the number of working days in the month. This gives a series showing daily average sales for each month. The number of days used for this adjustment is the six working days of the week, excluding legal holidays, and considering Saturday as one and one-third days. The link relatives of these daily averages are next computed, as is also the $\frac{\text{May}}{\text{February}}$ relative for each year.

Since both March and April are affected directly by the date on which Easter occurs, the March, April, and May link relatives are accordingly affected. The relative, $\frac{\text{May}}{\text{February}}$, however, should not be affected. This relative is the product of the March, April, and May link relatives.

$$\frac{\text{March}}{\text{February}}\times\frac{\text{April}}{\text{March}}\times\frac{\text{May}}{\text{April}}=\frac{\text{May}}{\text{February}}.$$

Since $\frac{\text{May}}{\text{February}}$ is not influenced by the date of Easter, we can use it to check and balance the three changing links which have been computed for March, April, and May.

The average link relative for each month has been computed from the actual relatives from February, 1919, through January, 1933. The type of average used in a study depends, of course, somewhat upon the data in hand. The averages as herein computed are broadened medians—the averages of the mid-four relatives for the fourteen years, arranged in order of magnitude, the five highest and the five lowest items being eliminated. The average link relatives for March, April, and May are not computed, but the average $\frac{\text{May}}{\text{February}}$ relative is included. Table I shows these averages together with the computation columns *B*, *C*, and *D* according to the Person link-relative method for computing indices of seasonal variation.

Since the $\frac{\text{May}}{\text{February}}$ relative is the product of the February, March, and April link relatives, it can be multiplied by the February chain relative to give the correct May chain relative shown in column B.

The March, April, and May link relatives can now be dealt with separately. The accompanying scatter diagrams show the link relatives for each of these months. Each point is labelled for the year to which it applies, and is plotted according to the date upon which

LINK RELATIVES OF CHAIN STORE SALES
PLOTTED ACCORDING TO DATE OF EASTER

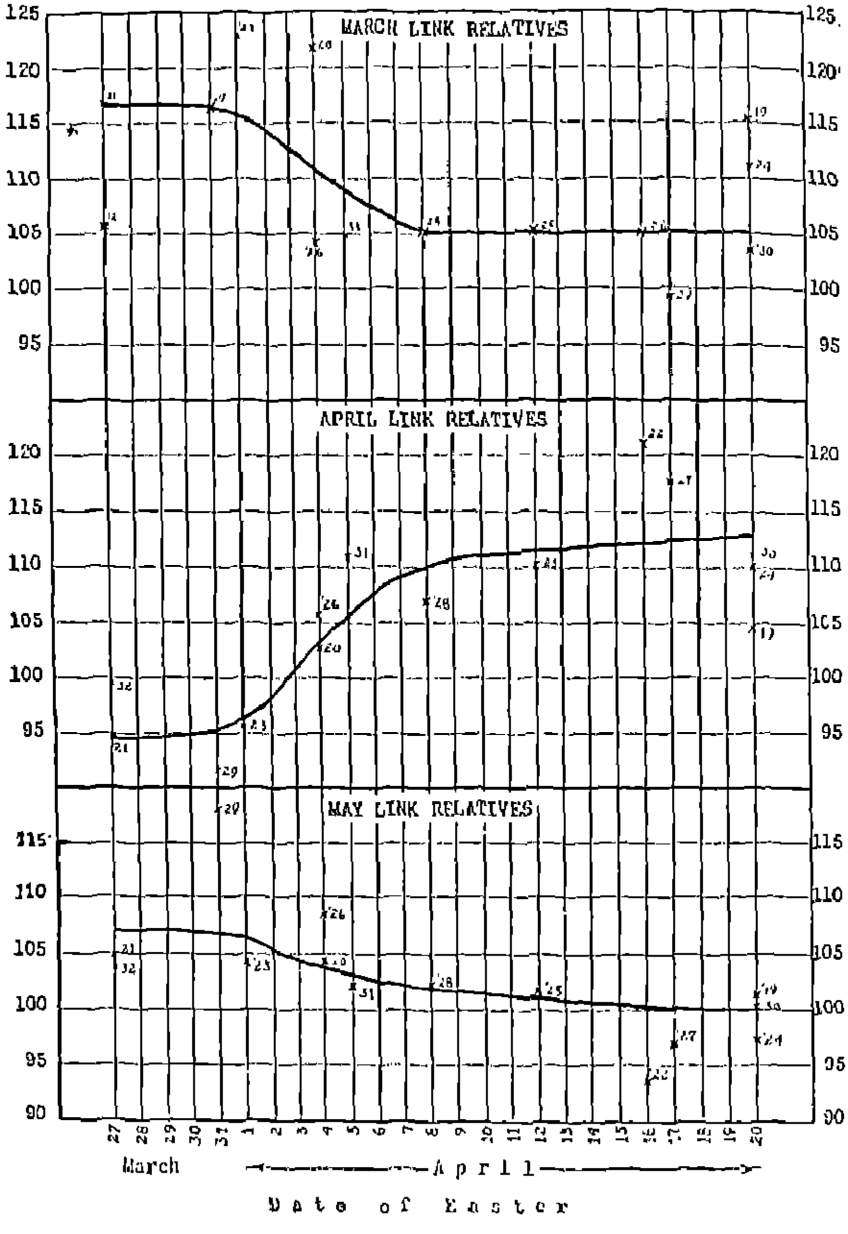

TABLE I

Month	*A* Average link relatives	*B* Chain relatives	*C* Correction divisors	*D* Corrected chain relatives
January	40.4	100.0	1.000	100.0
February	111.2	111.2	1.004	110.8
March	.....	.....	1.007	.....
April	.....	.....	1.011	.....
May	118.6	131.9	1.015	130.0
June	94.7	124.0	1.019	122.0
July	97.0	122.3	1.022	119.7
August	100.8	123.3	1.026	120.2
September	*105.5*	*130.1*	*1.030*	*126.3*
October	110.0	143.1	1.034	138.4
November	102.1	146.1	1.037	140.9
December	177.0	258.6	1.041	248.4
January	40.4	104.5	1.045	100.0

Easter fell in that year. As would be expected, the earlier the date of Easter, the higher the link relative for March, and the lower that for April, and (since May sales are not affected) the higher the link relative for May. A smoothed curve has been drawn on the diagrams representing what seems a reasonable trend of the actual relatives. This curve can be drawn free-hand, and even the first try, if carefully done, can give fairly good results.

Table I gives 118.6 as the average $\frac{\text{May}}{\text{February}}$ relative—the product of the link relatives for February, March, and April. The product of the corresponding points for each date on these three smoothed curves should, therefore, give this result. Rough first smoothings can, accordingly, be refined by being adjusted to this product. The points on the curves as computed for Chain Store Sales are given in Table II.

Having these results in hand, the proper seasonal indices for any year can be computed by filling in the chain for March and April according to the above relatives for the date upon which Easter falls in that year, and so completing the series for the twelve months.

Table III shows the computation for 1931, 1932, and 1933 when the date of Easter is April 5th, March 27th, and April 16th respectively. The chain series and the correction divisors remain as in Table I. The March, April, and May link relatives when applied to the February chain relative, will, of course, always give the same May chain relative, since this method has so provided.

The difference in the March and April corrected chain relatives makes a difference in the arithmetic average for the different years, but this difference will always be too small to cause a significant difference in the indices of seasonal variation for January and February, and May through December for different years.

TABLE II

A Date of Easter	*B* $\frac{\text{March}}{\text{February}}$	*C* $\frac{\text{April}}{\text{March}}$	*D* $\frac{\text{May}}{\text{April}}$	*E* $\frac{\text{May}}{\text{February}}$ $B \times C \times D$
March 27th	116.9	94.7	107.1	118.6
28th	116.9	94.7	107.1	
29th	116.9	94.7	107.1	
30th	116.8	94.9	107.0	
31st	116.5	95.2	106.9	
April 1st	115.8	96.2	106.6	
2nd	114.6	98.0	105.6	
3rd	112.8	100.6	104.5	
4th	110.7	103.2	103.8	
5th	108.9	105.5	103.2	
6th	107.4	107.5	102.7	
7th	106.3	109.0	102.3	
8th	105.6	110.1	102.0	
9th	105.3	110.7	101.7	
10th	105.1	111.1	101.5	
11th	105.1	111.4	101.3	
12th	105.1	111.6	101.1	
13th	105.1	111.8	100.9	
14th	105.1	112.0	100.8	
15th	105.1	112.2	100.6	
16th	105.1	112.4	100.4	
17th	105.1	112.6	100.2	
18th	105.1	112.7	100.1	
19th	105.1	112.8	100.0	
20th	105.1	112.8	100.0	

TABLE III

Month	Link relatives			Chain relatives			Corrected chain relatives			Indices of seasonal variation		
	1931	1932	1933	1931	1932	1933	1931	1932	1933	1931	1932	1933
January	.....	.....	.....	.....	.....	.....	100.0	.....	.....	74.8	74.9	74.8
February	.....	.....	.....	111.2	.....	.....	110.8	.....	.....	82.9	82.7	82.9
March	108.9	116.9	105.1	121.1	130.0	116.9	120.3	120.1	116.1	90.0	96.3	86.9
April	105.5	94.7	112.4	127.8	123.1	131.4	120.4	121.8	130.0	94.6	90.9	97.3
May	103.2	107.1	100.4	131.9	131.9	131.9	130.0	.....	.....	97.3	97.0	97.3
June	.....	.....	.....	.....	.....	.....	122.6	.....	.....	91.7	91.5	91.8
July	.....	.....	.....	.....	.....	.....	119.7	.....	.....	89.6	89.3	89.6
August	.....	.....	.....	.....	.....	.....	120.2	.....	.....	89.9	89.7	90.0
September	.....	.....	.....	.....	.....	.....	126.3	.....	.....	94.5	94.2	94.5
October	.....	.....	.....	.....	.....	.....	138.4	.....	.....	103.5	103.3	103.6
November	.....	.....	.....	.....	.....	.....	140.9	.....	.....	105.4	105.1	105.4
December	.....	.....	.....	.....	.....	.....	248.4	.....	.....	185.8	185.4	185.9
Average	.....	.....	.....	.....	.....	.....	133.7	134.0	133.6	100.0	100.0	100.0

The same general principles applied in the above analysis can be applied in connection with other methods than the link relative to compute seasonal indices which will allow for the changing date of Easter. If the thirteen-months-ratio-first-difference method [1] is used, the discrepancy noted in the preceding paragraph will not appear.

[1] This method for computing seasonal variation is described by A. O. Baumann in the September, 1928, issue of this JOURNAL.

COMMITTEE ON GOVERNMENT STATISTICS AND INFORMATION SERVICES

Jointly sponsored by the American Statistical Association and the Social Science Research Council, provided with an appropriation for one year of operation by the Rockefeller Foundation, and with its proffer of "immediate assistance and advice in the reorganization and improvement of the statistical and informational services of the federal government" accepted by the Secretaries of Agriculture, the Interior, Commerce and Labor, this Committee began active work in Washington early in June. It is designed, to an extent consistent with continuity, to be flexible in personnel and program. It is to be represented in Washington at all times with a working quorum of its membership, and with a staff adapted to the problems upon which it may be engaged. The membership during the summer quarter, as jointly designated by Mr. Robert T. Crane on behalf of the Council and Mr. Stuart A. Rice on behalf of the Association, consists of Edmund E. Day, Chairman, Stuart A. Rice, Acting Chairman, Meredith B. Givens, Executive Secretary, Bryce M. Stewart, Morris A. Copeland, Willard L. Thorp and William L. Crum. This personnel is intended to secure representation for the interests not only of the Council and the Association, but as well for the Joint Advisory Committee to the Census of the Statistical and Economic Associations; the Joint Committee on Income Tax Statistics of these Associations and the American Association of University Professors in Accounting; and the Statistical Association's Special Advisory Committee to the Secretary of Labor. Members of the Committee have participated actively in the Committee's enterprise during its initial stages. Other members of the Association who have been engaged on behalf of the Committee in various phases of its work include Woodlief Thomas, Joseph B. Hubbard, Margaret Klem, Jacob Perlman, A. Howard Myers, and Hilding Anderson. The Committee is coöperating closely both with the established statistical agencies of the federal government and with the newer organizations which are being established under the agricultural and industrial recovery programs. It is occupying offices in Room 5519 Commerce Building and Room 716 Labor Building, in Washington.

One of the first activities of the Committee was the preparation of an extensive memorandum addressed to Honorable John Dickinson, Assistant Secretary of Commerce, and to Dr. Alexander Sachs, Chief, Division of Research and Planning, Industrial Recovery Administration, on "The Statistical Services of the Federal Government in Relation to the Recovery Program." Other early Committee interests have related to the Federal Statistics Board, the Marketing News Service of the Department of Agriculture, certain activities of the Bureau of Foreign and Domestic Commerce and the Bureau of Mines, the statistical and research program of the Federal Conservation Work, and various statistical problems of the Department of Labor. The latter have been given particular attention by the Special Advisory Committee to the Secretary of Labor, established at her request by the Association, the work of which is elsewhere discussed in the JOURNAL. This work is being financed by the Committee on Government

Statistics. A study of the statistical work of his department has been requested by the Secretary of the Interior, but this has not yet been undertaken at the time of this writing (July 7, 1933).

STUART A. RICE

FIFTEENTH CENSUS REPORTS ON POPULATION

The 1930 Census Reports on Population have now been published and occupy six volumes, with two additional volumes devoted to unemployment statistics.

Volume I of these reports gives the total population, without classification, for states, counties, cities and other incorporated places, townships or other minor civil divisions, and the wards of cities having a population of 5,000 or over.

Volume II is the general report on population and contains the most detailed of the tabulations by sex, color, nativity, age, etc. Figures are presented in this volume by states, with extensive tabulations for urban, rural-farm, and rural-nonfarm areas; in practically the same detail for cities of 500,000 or more; and in more condensed form for cities of 25,000 to 500,000. Comparative figures for one or two earlier censuses are usually given, and under each subject is a historical summary table presenting the data for the United States as a whole back to the earliest possible date. The subjects covered by this volume are indicated by the titles of the chapters, which are as follows:

1. Urban and Rural Population, Metropolitan Districts, and Center of Population
2. Color or Race, Nativity, and Parentage
3. Sex Distribution
4. State of Birth of the Native Population
5. Country of Birth of the Foreign Born
6. Country of Origin of the Foreign White Stock
7. Mother Tongue of the Foreign-born White Population
8. Citizenship of the Foreign Born
9. Year of Immigration of the Foreign Born
10. Age Distribution
11. Marital Condition
12. School Attendance
13. Illiteracy
14. Inability to Speak English

Volume III, which comprises 2,784 pages and is printed in two parts, presents less detailed statistics, state by state, under the following classifications: sex, color and nativity, age, country of birth, citizenship, marital condition, school attendance, and illiteracy, with preliminary figures for gainful workers classified by industry. All of these classifications are given by counties (with condensed tables for the rural-farm and the rural-nonfarm areas of the counties) and most of them for cities of 10,000 or more. Less detailed tables are given for incorporated places of 2,500 to 10,000, and still briefer presentations for incorporated

places of 1,000 to 2,500, for townships and for the wards of cities of 50,000 or over. Volume III is mainly to be used as a source of data for counties, for cities and other incorporated places having less than 25,000 inhabitants, for townships and for the wards of cities.

Volume IV gives the statistics of occupations, state by state. Gainful workers are here classified not only by sex and occupation, but also by color, nativity and age. Age is presented in detail for workers under 25 and then by 10-year periods up to 75. Special tables are presented for gainfully occupied women by marital condition, and for children in gainful occupations. The statistics are given in full detail for states and for cities of 100,000 or more, and in condensed form for cities of 25,000 to 100,000.

Volume V is the General Report on Occupations. In this volume the material is arranged by subjects rather than by areas, the chapter titles being as follows:

1. Enumeration and Classification of Occupations
2. Sex and Occupation of Gainful Workers
3. Color and Nativity of Gainful Workers
4. Age of Gainful Workers
5. Marital Condition of Occupied Women
6. Children in Gainful Occupations
7. Gainful Workers by Industry and Occupation

The explanatory material in Chapter 1 is very valuable for a clear understanding of the significance and limitations of the Census statistics of occupations. The classification of gainful workers in each industry by occupation, which is presented in Chapter 7, is an important contribution to the material for the analysis of the occupational status of the population of the United States. A similar classification was published in the reports of the Census of 1910.

Volume VI presents, state by state, the results of the 1930 tabulation of family data. There is no general report on families, though the United States Summary which stands at the beginning of Volume VI gives a considerable amount of summarized material for the United States, for states, and for cities of 100,000 or more. In this volume, statistics are presented for homes classified by tenure, for nonfarm homes classified by value or monthly rental, for dwellings, and for families classified by size, number of children, number of gainful workers, number of lodgers, color and nativity of head, age of head and employment status of home-maker. The number of families having a radio set is also given. These classifications are presented in varying degrees of detail for each state, by counties, with separate figures for urban, rural-farm and rural-nonfarm areas, and for cities and other incorporated places having 2,500 inhabitants or more. There are no family data for townships or for rural incorporated places, and no data on mortgaged homes.

Volume I of the Reports on Unemployment presents the data, state by state, including classifications by sex, color, nativity, age, family relationship, period of idleness and industry groups. Volume II is the General Report on Unemployment and presents the material by subjects. Most important of the new sub-

jects here presented are the classification of unemployment by occupation and the report of the special census of unemployment taken in January, 1931.

An excellent summary of the 1930 Census returns on population and unemployment is presented in the first half of the Abstract of the Fifteenth Census.

The material in all of the volumes listed above, except Volume II of Unemployment, has been published also in the form of bulletins or chapter reprints. Volume I is represented by the First Series of State Bulletins on Population; Volume III by the Second Series of State Bulletins on Population; Volume IV by the State Bulletins on Occupations; Volume VI by the State Bulletins on Families; and Unemployment, Volume I, by the State Bulletins on Unemployment. For each one of these series there is also a United States Summary Bulletin. The separate chapters of Volumes II and V are also available in the form of bulletins.

In addition to the regular reports, three special supplementary publications are now available, as follows: Metropolitan districts, foreign-born white families by country of birth of head, and age of the foreign-born white population by country of birth. A special report on the Indian population is ready for publication.

Circulars describing any of the Census volumes may be obtained upon request from the Bureau of the Census, Washington, D. C.

LEON E. TRUESDELL

COMMITTEE ON REPORTS AND STATISTICS OF THE AMERICAN PUBLIC WELFARE ASSOCIATION

The following is a digest of the report made at the Annual Meeting in Detroit, June 13, of the Committee on Reports and Statistics to its parent Association. Such material as does not deal with statistics or the Statistical Association has been omitted.

In line with one of the points in the Welfare Association's recommendations for standards in unemployment relief which makes it incumbent upon the state welfare departments to assemble state-wide data on unemployment, relief needs and relief expenditures, the Committee was pleased to coöperate with the Committee on Statistics of Relief and Child Care of the American Statistical Association (Neva R. Deardorff, Chairman) which recognized that there was definite need for study and coördination of the relief statistics now being compiled in the United States. It was recognized that state welfare departments are now setting up statistical series on relief which will undoubtedly persist for a long time and that every effort should be put forward to see that these systems are established on a sound basis. The close and cordial relations existing between the Welfare Association and the newly created Federal Emergency Relief Administration augurs well for the success of this undertaking.

This Committee was glad actively to participate in the work of the Advisory Committee on Child Welfare Statistics of the U. S. Children's Bureau, through which it is hoped to correlate existing statistical studies in the field, to secure

advice in connection with general policies of the social registration project, and to give specific consideration to the items of greatest importance to be collected and to the schedules to be used. It is planned to develop a handbook on child welfare statistics containing suggestions for basic records and statistics similar to those worked out in the fields of public health nursing and medical social service. This Committee is coöperating with the Committee on Statistics of Relief and Child Care of the American Statistical Association and the Advisory Committee on Statistics of the New York State Department of Social Welfare in working out an approved system for recording data in regard to child care in institutions and agencies in New York State. Appropriate forms for reporting, to the State Department of Social Welfare, the children taken under care and changes in their status while under care, have already been developed and a report is planned which will cover (1) all of the forms to be used in reporting to the state by these agencies, i.e., on individual children, on monthly movement of population and on annual income, expense and property transactions; and (2) the tables to be compiled from the data collected on these forms.

In connection with the New York State projects in registration of social statistics, this Committee, together with the Committee on Institutional Statistics of the American Statistical Association (Horatio M. Pollock, Chairman) and the Committee on Hospital Statistics of the American Hospital Association, has prepared hospital discharge schedules to be used by a small group of general hospitals in two of the larger cities of New York State. This schedule is designed primarily to show in addition to the usual identifying data regarding hospital patients, economic status of the patient, the preliminary and final diagnosis of his condition, the general nature of treatment, length of stay of patient and condition on discharge.

The Committee was happy to coöperate with the Law Institute of the Johns Hopkins University (Leon C. Marshall, Director) in its effort to work out "simple, inexpensive, readily mastered techniques, to secure a dependable, objective, generalized knowledge of a considerable part of the happenings in the trial courts"; and to extend the range of worthwhile criminal statistics to include the activities of the police, the prosecutor, the grand jury, the probation and parole authorities, the jail and prison authorities and the other agencies connected with the administration of criminal justice. In connection with the 1933 Prison Congress, this Committee is working with the Committee on Criminal Statistics of the American Prison Association (Edwin H. Sutherland, Chairman) in developing a program for the discussion of questions such as (1) For what purposes or occasions are statistical reports made in penal and correctional institutions? (2) What statistical studies are made for administrative purposes and is there a need for more statistical studies for administrative purposes? (3) What facilities exist for statistical work and in what respects should these facilities be improved? (4) Is there value in a long-time series of statistical tables which show trends, and for standardized forms that make possible comparisons of institutions?

Together with the Committee on Institutional Statistics of the American

Statistical Association, this Committee coöperated with the United States Bureau of the Census in the development of new and improved statistical schedules for use in the preparation of current and future reports of the Census Bureau, particularly on penal and correctional institutions, hospitals and institutions for mental and nervous diseases, and institutions for the mentally deficient and epileptic.

The Welfare Association and this Committee are participating in a three-year demonstration project in social statistics carried on by the Research Bureau of the New York State Department of Social Welfare which aims to establish the best methods of providing accurate information on the operation of social welfare agencies throughout the state. The results of this demonstration are expected to show what use is being made of public funds, the amount and kind of services provided by public and private agencies, and the distribution of the costs of such services between the agency groups.

Ostensibly as an economic measure a legislative bill introduced into the Pennsylvania Legislature (fortunately not approved) proposed to coördinate all of the social statistics collected by the Pennsylvania Department of Welfare in another department of the State Government. Asked by the Pennsylvania Secretary of Welfare for an expression of opinion regarding this proposal, the Committee has written protesting against such combinations and upholding Departments of Welfare.

The Committee on Reports and Statistics is composed of the following: A. L. Bowen, Illinois; Agnes K. Hanna, District of Columbia; Emma O. Lundberg, New York; Bennett Mead, District of Columbia; Horatio M. Pollock, New York; Elizabeth Yerxa, Wisconsin; and Emil Frankel, New Jersey.

INFLATION

A dinner meeting of the American Statistical Association was held on Thursday evening, April 20th, 1933, at the Hotel Woodstock, 127 West 43rd Street, New York City. Three hundred and thirty-four persons were in attendance. Professor Wesley C. Mitchell of Columbia University presided. The topic for discussion was "Inflation."

The first speaker of the evening was James Harvey Rogers, Professor of Economics at Yale University. He began by pointing out that the depreciation of the dollar resulting from the gold embargo was in considerable part psychological, as our long-run balance of international payments is still favorable.

Professor Rogers pointed out that the action of the United States in deserting the gold standard is quite contrary to precedent. In the past, many nations have been driven off the gold standard by forces beyond their control, but the United States took the step deliberately at a time when it was perfectly feasible to remain on a gold basis.

It is commonly believed that our going off the gold standard puts the United States in a stronger position to deal with other nations. The probabilities are

that fear of Hitler on the part of both Great Britain and France may make them more ready to come to an agreement with the United States than they would be under other conditions.

In the last analysis, all three countries want much the same thing. Genuine lasting recovery for all of us would be greatly facilitated by hard and fast agreements to move together toward: (1) A gradual and continued reduction of trade barriers throughout the world; (2) A raising of the world price level by an agreed upon percentage *and by no more;* (3) International coöperation in major money and central bank policies.

No reduction of the gold content of the money units should be undertaken unless done internationally and simultaneously. Independent devaluation would not only encourage the further growth of trade barriers of all sorts, but would most likely lead to an increased maldistribution of the world's monetary gold stocks.

There are many feasible ways of raising the price level. The difficulty is to stop the rise in prices when the point desired is reached. Nations in the past have often raised prices by inflationary policies. These inflationary policies have almost invariably resulted from unbalanced governmental budgets.

As the method most suitable at present for raising prices in the United States, Professor Rogers suggested the expenditure of large sums of money for the construction of public works. He held that the Federal Reserve banks should buy bonds in quantities sufficient to keep the member banks adequately supplied *with reserves. At the same time, the Federal Government should float bond* issues to pay for the public works. Since the member banks are still contracting the volume of deposit currency, the Government should, at the beginning, spend not less than seven hundred million dollars per month in order to assure the prompt return of prosperity. To make possible the flotation of such large issues, buyers would have to be guarded against depreciation in case the rate of return on later flotations were raised. A provision making all earlier issues redeemable (at the option of the holder) into any later ones is perhaps the simplest and safest device for accomplishing this purpose. The speaker closed by emphasizing the importance of arranging in advance to stop inflation whenever the price level rose higher than the goal determined upon as ideal.

The second speaker of the evening was Ralph West Robey, Financial Editor of the *New York Evening Post*. He opened by defining inflation as "creation of artificial purchasing power." Rising prices are not inflation but inflationary results.

Inflationists tell us that a rise in prices will lessen the debt burden. They overlook the fact that inflation normally results from the creation of debt by the Government. What happens is that Government debt is being substituted for private debt. The idea that inflation will help our foreign trade is largely fallacious, for, as soon as it produces the hoped-for result of raising domestic prices, all of our advantages in foreign markets disappear. The real force behind the inflation movement is mainly the desire of the speculative fraternity to foster activity in the stock market.

Mr. Robey stated that inflationists believe that rising prices will stimulate business, ease the burdens of debtors, and increase the volume of international trade. To accomplish these purposes, the following methods have been proposed: (1) Print paper money and use it to pay Government expenses; (2) Borrow heavily to meet the Government deficit; (3) Dilute the currency either by introducing silver as standard money or by reducing the gold content of the dollar; (4) Have the Federal Government or some of its subsidiary agencies lend money to bolster up tottering enterprises; (5) Disburse large sums for doles or expenditures on public works.

It is true that measures can be inaugurated which will raise prices. The difficulty is that, when prices are raised by inflationary methods, there is no way of saying which one shall be raised most. Our present troubles are due largely to the fact that prices are out of equilibrium. There is no reason to suppose that inflation would raise most those prices which have fallen most. Therefore, a rise in the average of all prices might leave price relationships as badly out of balance as they are at present. Furthermore, the fact must not be overlooked that, as long as private investors are taking money out of circulation, there is no certainty that the Government can raise prices by putting more money into circulation.

The policy followed by the Federal Administration since March 5th has been such as to undermine public confidence seriously. The banks, the insurance companies, and the mortgage guarantee concerns have all been forced to violate their contracts. In addition, the Federal Government has repudiated its own promises to pay gold on demand. It has even gone so far as to threaten with imprisonment citizens holding gold obtained by perfectly honorable means.

Confidence has been further shaken by the likelihood that the Farm Relief Bill will be passed. The provisions of this bill practically constitute a blank check on the Treasury. Once it is in operation, no one can ever ascertain the actual future situation of the Treasury. No one is able to guess what it will cost the nation. The Government has been going into the banking business. The reforestation program, which is starting out so innocently, is likely to attain titanic proportions. The latest proposal is that, if the Federal Reserve banks fail to purchase three billion dollars' worth of Government bonds in the open market, the Secretary of the Treasury will issue that amount of greenbacks. Each of these measures has undermined confidence.

The program which ought to have been inaugurated is in sharp contrast to the one which has actually been followed. Steps should have been taken to restore confidence in the American dollar. Unless we can, in some way, restore confidence, we will not have controlled inflation but we will have financial debauchery, exemplified by wild speculative activity followed by collapse within a few weeks or a few months at the most.

Dr. Robey's remarks were followed by discussion from the floor. Dr. Leland Rex Robinson inquired as to whether there is any evidence that depreciation of its currency tends to stimulate a nation's foreign trade. Professor Rogers felt this connection to be an established fact, but Dr. Rufus Tucker stated that

statistical inquiry shows that those European countries which have depreciated their currencies have not succeeded in increasing their exports. Professor Rogers contended that exports had continued to decline because of the downward movement of the business cycle and that they would have declined much further had it not been for the currency depreciations in the countries mentioned. Dr. Tucker retorted that this failure of exports to respond to currency depreciation was characteristic of various countries at various times in all phases of the cycle, and is not confined to periods of falling business.

Mr. Donald B. Woodward took issue with Dr. Robey's contention that an increase in the general price level would not raise most those particular prices which have fallen most. Mr. Woodward asserted that the fact is thoroughly established that prices of certain commodities fluctuate more readily than do those of other commodities. It is in recognition of this principle that index numbers of sensitive prices are constructed. There is, then, every reason to anticipate that any force tending to raise the average of prices will be responded to most readily by those sensitive commodities which have declined most during the past three years.

Mr. Woodward also felt that Dr. Robey, in his fear that life insurance and other savings will be rendered worthless by a policy of inflation, overlooked the fact that the deflation policy which we have been experiencing, if continued, will wreck both insurance companies and banks as it has already wrecked real estate mortgages and many commercial banks.

Mr. Woodward questioned also whether Dr. Robey's desire to balance the national budget could be attained were deflation allowed to run its natural course. Only with rising prices will taxes be productive enough to make budget balancing feasible.

Mr. Robert B. Warren agreed with Dr. Robey that repudiation does nothing to stimulate the making of new long-term contracts. Without such new contracts, business recovery can scarcely take place. Recent legislation may, therefore, do much to hinder business recovery.

Dr. George F. Bauer expressed the view that April, 1933, is a strange time to begin worrying about the integrity of the dollar. The people now so much concerned about it should have taken measures in 1930 to retain its integrity. The important question now is what measures can be taken which will help us pay our debts.

Dr. Bauer felt that our monetary difficulties were largely caused by the erection of tariff barriers, for these barriers have prevented commodity movements between countries and have, therefore, led to a wild scramble for gold.

Mr. Joseph V. Sherman expressed the opinion that one must have great faith if he still believes that prosperity can be restored merely by utilizing some abstraction like confidence. We have been playing the "confidence game" for three years, yet conditions have been steadily growing worse. What we need is more buying power for consumers. In a large proportion of families, purchasing power is practically exhausted.

Mr. Sherman also brought out the point that the ratio of total indebtedness

to total national wealth has been expanded to a point at which, if our present shrunken price level is maintained, it is practically impossible to pay all the debts.

Mr. Victor von Szeliski advanced the hypothesis that the reason that foreign trade does not respond readily to depreciation of the currency in any given nation is because tariff barriers and quota regulations prevent goods from moving freely from country to country.

WILLFORD I. KING, *Secretary*

WHO SHALL INHERIT AMERICA?

A joint meeting of the Population Association of America and the American Statistical Association was held, on May 12, 1933, at the Town Hall Club in New York City. Over one hundred members and guests attended.

Robert E. Chaddock, Past President of the Statistical Association, presided. The discussion centered upon the relation of the differential rate of natural increase among social classes to the quality of the population of the United States. Two papers were read, one by Dr. Frank Notestein, of the Research Department of the Milbank Memorial Fund, the other by Professor Frank H. Hankins of Smith College.

The first paper reviewed the factual situation with reference to differential natural increase among classes in the United States. There was general agreement as to the following observations: (1) The lower social classes increase more rapidly than the upper in each type of urban community and in rural areas. The rural classes increase more rapidly than the urban, and each urban class increases more rapidly in small than in large communities. (2) Probably this more rapid increase in the lower than in the upper classes goes back well into the nineteenth century. (3) The differences arise partly from differences in marriage age and, possibly, in the proportion of those who marry, but they are also the result of differences in fertility which are independent of these factors. The evidence suggests that they are in some measure attributable to the greater prevalence of purposive control of fertility in the upper than in the lower classes, even prior to 1910. (4) These differences in fertility are somewhat modified by the relatively high mortality rates of both adults and children which are characteristic of the lower classes. However, the influence of this factor is not sufficiently great to overcome that of differential fertility in bringing about the inverse relation between the rate of increase and social status.

The second paper, citing additional evidence from Western nations, accepts the conclusion that differential fertility, and consequent differential rates of natural increase among social classes, is a real phenomenon and not a new one. The discussion now centers upon the question, *Is differential fertility truly selective as regards the quality of the population?* To be selective differences of net fertility must be associated with inherent biological differences. If population is of uniform biological quality from class to class there is no selection. The conditions which would prove most definitely selective would be

(1) that the higher social classes are biologically of superior social worth, however this worth may be measured, (2) that the net size of families is less in the higher classes, (3) that more relatively of the upper classes fail to marry, and (4) that their average age of marriage is greater, thus allowing a longer span between generations. Professor Hankins concludes, in the light of our present knowledge, that all of the above conditions are fulfilled in both England and the United States.

The main question at issue is whether there are measurable differences in the biological quality of the social classes, estimated either in terms of physical traits or in terms of mental traits. Studies have shown physical differences, but in many cases the differences themselves are not imposing and might easily be explained by the cumulative effects of environmental factors; and in some studies the evidence is conflicting. The evidence seems more convincing from studies of mental differences. Mental ability appears to be correlated positively with social class, whether we distinguish social class by income, occupation or education. Professor Hankins cites the investigations of Lentz, Clark, Sutherland, Thomson and others in support of the hypothesis that intelligence of parents is negatively correlated with number of offspring; and that the intelligence of children is positively correlated with social status.

But all this evidence does not demonstrate that the upper classes are of superior biological quality. Superior mental ability is associated with superior environmental opportunity and vice versa. Assuming that the concept of mental levels is a valid one, we still face the difficult problem of determining the relative weights of the hereditary and environmental factors in determining mental levels. Professor Hankins marshals the evidence from studies of twins and orphans made by Wingfield, Sandiford, and Holzinger; the results of investigations among institutional populations which seem to indicate that the life in institutional homes has little or no tendency to make boys and girls more alike in I.Q.'s—studies made by Carr-Saunders, Lawrence, Wingfield, Hildreth and Davis, and Barbara Burks. From this evidence he concludes that the correlation found between intelligence and social status *is largely a consequence of the differences in the biological worth of the social classes. In other words, differential fertility is probably selective.*

This conclusion, Professor Hankins believes, is supported by certain *a priori* considerations. The more able men in the lower classes move upward. It is the conscious aim of our democracy to provide an open road for talent. Universal free education is designed to facilitate this movement. So far as innate intelligence is a factor in success, we should expect to find more of it at the top than at the bottom of the social scale. The cultural evolution through which we have been passing has called for all the latent talent which the population could supply. Moreover, the failure of the upper classes to add their full quota to succeeding generations has left vacancies to be filled from lower levels.

The total effect of these processes seems to Professor Hankins to be dysgenic. Our democracy has produced biological stratification. Assortative mating renders each level more like in its biological constitution. The differential birth

rate thus seems to be selective. We do not know, assuming the above to be a true picture, how rapidly this selection is going on. Moreover, changes in the birth rates, especially among the lower strata, may modify the dysgenic influence or eliminate it altogether.

The discussion of the two papers was opened by Dr. Frank Lorimer of the Eugenics Research Association, followed by Dr. Louis I. Dublin, Statistician and Vice President of the Metropolitan Life Insurance Company, and by Dr. Earl T. Engle of the College of Physicians and Surgeons, Columbia University. Dr. Lorimer thought the facts suggest that present differential fertility may be, in part, the expression of a lag in the spread of the pattern of family limitation among social classes. The differentials may soon tend to disappear through a leveling down of birth rates in the lower classes. Eventually birth rates in the upper classes may be raised by conditions more favorable to natality. In the meantime, economic and social measures which make rural life more attractive to superior families would be important from the standpoint of the quality of the population.

He emphasized the importance of determining trends in fertility by social classes, and urged repetition in the Sixteenth Census of the inquiry, "Number of children ever born?" in order to make possible a continuation of the Milbank Fund analyses over another decade. He also recommended that the analysis, discontinued since 1929, of birth registration data according to the age of the mother and the occupation of the father be taken up again by the Division of Vital Statistics of the Census Bureau. He argued in favor of closer attention in research to the operation of reproduction differentials in the transmission of characteristics developed through the operation of both hereditary and environmental forces.

Dr. Dublin, accepting, for the most part, the objective evidence presented in the papers, differed radically as to the significance of differential fertility among the social classes. He does not believe that it is a dysgenic influence, endangering the quality of our future population. He is assured from experience with health and insurance statistics that there is no fundamental difference between social classes in innate physical qualities. He would deny the conclusion which Professor Hankins cautiously draws from his evidence on the relation of mental ability to social status, that the upper classes are of superior biological quality and that the differentials, therefore, are selective. Mental differences between classes, he attributes also, for the most part, to environmental opportunity or to social handicaps. He maintains that we make our own poor.

In fact, Dr. Dublin criticizes fundamentally our entire concept of quality as at present defined, and questions the criteria used in the past to describe it—high intelligence as measured by I.Q., economic success, social position. He argues strongly for a new criterion, that of character. He would prevent, so far as possible, propagation of the degenerate and defective, but he is not seriously concerned with the effects of differential fertility among social classes. The environment should be modified so as to permit the young of all classes to develop to the fullest degree the innate qualities which they possess.

Dr. Engle closed the discussion by calling our attention to some of the physiological capacities involved in the concept of maximum fertility. He warned us also that "the physical and physiological characters which make for success in a profession or business are not the same as those which make good breeders. As a group, it seems biologically impossible that the same group should do both."

ROBERT E. CHADDOCK

Columbia University

PROGRESS OF WORK IN THE CENSUS BUREAU

THE ECONOMY PROGRAM

The general reduction in Government expenditures under the present economy program has, of course, affected the work of the Bureau of the Census, necessitating a readjustment of its plans for the current year and a curtailment of its activities, as the amount finally allotted to the Bureau is only about two-thirds of the amount asked for and estimated as necessary for carrying on its regular work without reducing salaries.

About one-half the reduction in the appropriation was automatically covered by the 15 per cent cut in Government salaries which went into effect on April 1. The remainder will have to be met mainly by a curtailment of the work of services of the Bureau, with possibly some further reduction of salaries through furloughs.

Some of the statistical inquiries which the Bureau has been conducting in recent years are not directly provided for or authorized by Act of Congress but were undertaken by order of the Secretary of Commerce under authority conferred by a general provision of the organic act establishing the Department of Commerce. Now that a reduction in the work of the Bureau is necessary because of reduced appropriations, it was considered that these inquiries, which were never sanctioned by Congress, not being expressly mentioned in the law defining the duties or functions of the Bureau, should be among the first to go. One of them is the annual compilation of statistics of marriage and divorce. It will be omitted for the year 1933. The compilations of current statistics of production (except those relating to cotton production) come into the same category—and have not been provided for in the budget of the Census Bureau. But in view of the great importance of these statistics at this time, the National Recovery Administration has sponsored this branch of work and will supply the funds necessary to carry it on in the Bureau with its present scope and detail for a period of at least six months, when the work may be placed on a more permanent basis and perhaps expanded.

The annual compilation of financial statistics of cities, which as provided by law, regularly covers all cities of 30,000 and over, will by Executive order be limited to cities of 100,000 and over. The compilation of financial statistics of states, being another of the inquiries not directly authorized by statute, will be omitted altogether for the current year.

A considerable saving will be effected by reducing the scope and detail of the

next biennial census of manufactures, which covers the year 1933 and will be taken in the latter half of the current fiscal year. In order to eliminate the expenses of field work and make it possible to collect the data by mail, the census will be confined to the principal industries, the minimum size of the establishments to be included in the canvass will probably be increased, and the schedules will be simplified. The census of 1931 included no establishments having an annual production of less than $5,000. It is probable that the limit for the next census will be raised to $20,000, perhaps even higher. A change of this kind reduces very materially the total number of establishments to be canvassed, without, at the same time, greatly reducing the other totals for the industries. For instance, increasing the minimum limit from $5,000 to $20,000 will reduce the number of establishments to be canvassed by nearly 33 per cent while producing a reduction of only 2.3 per cent in the number of wage earners and of hardly more than 1 per cent in the total value of products covered by the census.

The decennial census of institutional classes, as described in the March issue of this JOURNAL, will also have to undergo some curtailments. The census of jails, in which it was planned to obtain individual returns for prisoners committed during the year 1933, will cover only six months of the year. The census of paupers in almshouses will be postponed presumably until next year, as will also the inquiries with respect to charitable institutions for adults—such as soldiers' homes, old-ladies' homes, etc.—and likewise all the inquiries with respect to institutions for the care and placement of children.

With these curtailments in the scope and detail of its work the Bureau will probably be able to keep within the sum allotted to it for the collection of statistics, without reducing its present force by dismissals and without any very extended furloughs.

THE PRINTING SITUATION

The situation as regards the allotment for printing is much more serious. The lump sum allotted to the Department of Commerce for printing was reduced below the estimate; and the share that comes to the Bureau of the Census is entirely inadequate to cover the amount of printing that would regularly be done in the current fiscal year. Moreover, in addition to the reports that will regularly be completed this year, there are eight volumes of the reports of the decennial census still to be printed. These were all in type in the hands of the Government Printing Office and released for printing before July 1, and some of them had been printed and were ready for binding. As conditions were formerly they could be completed and charged against the unexpended balance of the appropriation for the previous year. But under the present budget regulations all work done on these volumes after July 1 will have to come out of the allotment for the current year. It is not clear at this time just how this situation can be met, but certainly some arrangement must be made whereby these volumes, as well as the reports for other inquiries that will be brought to completion within the current fiscal year, can be printed without any material abridgment or delay.

J. A. H.

MISCELLANEOUS NOTES

The Boston Chapter.—A luncheon meeting of the Boston Chapter was held on Friday, March 31, at the Boston City Club. The subject for discussion was "Present Conditions in Business and Finance." The discussion was led by Professor J. F. Ebersole of the Harvard School of Business Administration, Mr. N. E. Peterson, Economist, First National Bank, Boston, and Mr. Edward A. Filene of William Filene's Sons Company. Professor Ebersole spoke particularly with reference to general economic conditions and the credit situation. Mr. Peterson discussed financial conditions, and Mr. Filene spoke with reference to business conditions and measures for reconstruction. Following the brief addresses, there was spirited discussion of points raised by the several speakers.

At this meeting the President, Mr. Leroy D. Peavey, appointed Professor W. L. Crum of Harvard University and Mr. Howard C. Baldwin of Babson's Statistical Organization as members of a Committee to act with representatives of other organizations in preventing the impairment of essential social and scientific services which might result from a reduction in public expenditures.

The Sixth Annual Meeting of the Boston Chapter was held in the Auditorium of the Boston City Club on Friday evening, May 26, 1933. Dinner was served at 6.30 P. M.

Business Session: The business session was called to order at 7.30 P. M. by the President, Mr. Leroy D. Peavey, who reported with reference to the meetings held during the past year and recommended that, in addition to quarterly evening meetings, informal luncheon meetings be held occasionally. The annual reports of the Secretary-Treasurer were read and approved.

Officers elected for the ensuing year are: President—Professor J. Franklin Ebersole, Harvard Graduate School of Business Administration; Vice-President—Edmund S. Cogswell, First Deputy Commissioner of Insurance, Massachusetts Department of Banking and Insurance; Secretary-Treasurer—Roswell F. Phelps, Director of Statistics, Massachusetts Department of Labor and Industries; Counsellors—T. Frederick Brunton, Assistant Actuary, John Hancock Mutual Life Insurance Company; Howard C. Baldwin, Babson's Statistical Organization.

Speaking Session: The general topic for consideration at this meeting was "Inflation." Mr. E. C. Harwood, Assistant Professor, Massachusetts Institute of Technology, and author of *Cause and Control of the Business Cycle* was the principal speaker. The subject of his address was "Inflation: Possibilities of the Future." As a background for his remarks he described the distributing mechanism and the money-credit system as they have operated during the past, and displayed several illustrative charts. With reference to the future he stated as his opinion "that the best to be expected from devaluation of the dollar is a recovery, perhaps somewhat prolonged, but a later collapse which will presumably *not* bring the price level back to its recent low level. The net effect will probably be to lower somewhat the normal long term trend of industrial production."

The discussion was led by Mr. John H. Wills, First National Bank, Boston; Dr. Joseph B. Hubbard, Editor, *Review of Economic Statistics*, and Professor Donald S. Tucker, Massachusetts Institute of Technology.

The Chicago Chapter.—The final dinner meeting of the Chapter for the 1932–33 season was held on Tuesday, May 9, with Professor Garfield V. Cox, of the School of

Business, University of Chicago, as speaker of the evening. His topic, "The Administration's Recovery Program," brought out the largest attendance of the year. He discussed the Program in its relation to the field of money and prices, and pointed out which of the (at that time proposed) measures constituted deflationary and which inflationary action. The President's policy materially to raise the price level, he felt to be unwise, even though the rise could be checked through the various means of credit control, as the disparities between costs and price levels are not so serious as to warrant a considerable rise which might regenerate an unsound boom period. Professor Cox stated that the paramount need at the present is to restore employment and payrolls, and that foresight and courage are needed to recognize that all problems cannot be solved by inflation—a more balanced economy is needed. As regards the industrial control policy of the President, Professor Cox believes that the instrumentalities of government must be better perfected before political means of accomplishing economic ends can be successfully employed. However, he was rather encouraged by the President's efforts in the early weeks of his administration and pointed out that, after all, something depends on us.

The following officers and directors for the year 1933–34 were elected at this meeting: President, John L. Sweet, Federal Reserve Bank of Chicago; Vice-President, Dr. Howard B. Myers, Bureau of Labor Statistics, Illinois Department of Labor; Directors: John H. Noble, Armour and Company, H. B. Stair, Illinois Bell Telephone Company, and J. Gilbert, Mandel Brothers. Miss Marion Mead, Illinois Chamber of Commerce, will be the district secretary.

The Connecticut Chapter.—The Chapter held a dinner meeting in New Haven on April 26 with a record attendance. Professor James Harvey Rogers spoke on "Public Works vs. Inflation"; general discussion was opened by Professor Hudson Hastings. Meetings in Hartford and Bridgeport will be instituted in the fall.

Activities in Cleveland.—The final meeting of the Business Statistics Section was held on May first, at which time the members projected the Annalist Index of Business Activity.

The ninth annual meeting of the Cleveland members of the Association and the sixth meeting of the formal Cleveland Chapter was held at the Cleveland Chamber of Commerce Club on May 15. Forty-two members and guests were present. Mr. Green, retiring President of the Chapter, presided. Mr. Wembridge, Chairman of the Nominating Committee, presented the following nominations for officers for 1933–34: President: Dr. C. E. Gehlke, Western Reserve University; Vice President: D. A. Hill, Ohio Public Service Corporation; Secretary: E. A. Stephen, The Ohio Bell Telephone Company. The above nominees were elected.

Dr. Gaius E. Harmon, Associate Professor of Hygiene and Vital Statistics, Medical School, Western Reserve University, presented a paper on the "Measurement of the Influence of Certain Factors upon the Likelihood of Recovering from Lobar Pneumonia."

"Common Stocks in the Long Term Portfolio" was the subject of a paper presented by Gilbert Harold, College of Commerce and Administration, Ohio State University.

Howard W. Green, President of the organization during the past year, explained the purpose and methods used in the "Cleveland Real Property Inventory."

The Chapter was fortunate in persuading William F. Ogburn, past President of the American Statistical Association and Chairman of President Hoover's "Research Committee on Social Trends" to discuss the methods used by the Committee in its

work and to recount some of the obstacles met. Mr. Ogburn discussed some of the broader conclusions to which the Committee came in the course of its work.

The Columbus Chapter.—An unusually wide variety of subjects was presented by the speakers at the meetings of the Columbus Chapter in the year 1932–33. The papers were uniformly excellent and the discussions spirited. The average attendance at the meetings was thirty people. Dr. C. A. Lively, as president, Dr. R. W. Tyler, as executive secretary, and Dr. R. L. Dewey and Dr. H. A. Toops, as members of the executive committee, rendered very capable services to the club throughout the year.

The cost of government was the general topic of the October meeting. The national aspect was presented by Dr. H. F. Waldradt; the cost of state government in Ohio, by W. D. Hooper; and cost of local government in Ohio by H. R. Moore. The discussion was lead by R. C. Atkinson, B. A. Wallace, and Dr. H. H. Davis.

Dr. Viva Boothe and Dr. C. A. Dice presented papers on the current business outlook at the November meeting.

Experimental education was the general topic of the December meeting. Dr. F. H. Lumley presented a paper on statistical implications of studies of radio education; Dr. H. A. Edgerton discussed the application of statistics in educational guidance; and Dr. Fred P. Frutchey presented a paper on quantitative evaluations in college education.

The use of statistics in biology and in medicine was the topic of the January meeting. An illustrated talk on goiter was presented by Dr. George M. Curtis and a paper on statistics in the study of human heredity was presented by Dr. L. H. Snyder. The discussion was led by Dr. F. A. Hitchcock and Dr. Samuel Renshaw.

The February meeting was devoted to the international debt situation with Dr. Clifford L. James and Dr. Virgil Willet as the principal speakers. A lively general discussion followed the scheduled talks.

Recent changes in the agricultural situation were discussed by C. R. Arnold, Dr. V. R. Wertz, and P. G. Beck at the March meeting.

Recent changes affecting family life was the general topic of the April meeting. A paper on recent changes in consumer habits was presented by Dr. Grace M. Zorbaugh; W. J. Blackburn, Jr., presented a paper dealing with unemployment in Columbus and Cincinnati; and R. L. Dickinson, Secretary of the Columbus Community Fund, and L. S. Ford, publicity director of the Columbus Community Fund, presented material on indices of social service in Columbus since 1929.

The June meeting was devoted to statistical theory with a paper on small sample theory, read by Dr. C. C. Morris, and a paper dealing with new devices for aiding large scale research by Dr. H. A. Toops.

At the May meeting the following men were elected to office for the year 1933–34: President, Dr. R. W. Tyler; Executive Secretary, H. G. Brunsman; member of the Executive Committee for the two year period 1933–35, Dr. C. E. Lively. · Dr. Ralph L. Dewey will serve the second year of his two-year term as member of the Executive Committee in 1933–34.

The Pittsburgh Chapter.—"The President's Program for Recovery" was the subject at the luncheon meeting of the Chapter, held at the Harvard-Yale-Princeton Club on Thursday, April 27. Former Mayor William A. Magee of Pittsburgh made the principal address, and M. W. Acheson, well known local attorney, led the discussion.

F. J. Chesterman, vice-president of the Bell Telephone Company of Pennsylvania,

discussed the report of the committee on the relation of consumption, production and distribution, of the American Engineering Council, at the May 25th meeting. Mr. Chesterman served as a member of this committee, which made an exhaustive study of the problem, and presented an analysis of the forty causes of business instability which were arrived at.

The very timely subject, "Inflation," was taken up at the meeting on Thursday, June 22. Dr. R. J. Watkins, Director of the Bureau of Business Research at the University of Pittsburgh, was the speaker.

Advisory Committee to the Secretary of Labor.—This Committee, whose appointment was announced in the June issue of the JOURNAL, is now affiliated with the newly established Committee on Government Statistics and Information Services. Staff services and a substantial fraction of the funds at the disposal of the general committee are allocated to this work in labor statistics, which has been planned in direct consultation with the Secretary of Labor.

The Advisory Committee has devoted particular attention to the immediate improvement of the current indexes of employment and the statistics of retail prices and the cost of living as compiled by the Bureau of Labor Statistics. In consultation with a special sub-committee, Miss Aryness Joy of the Division of Research and Statistics of the Federal Reserve Board, has developed a detailed procedure for adjusting the employment indexes to the Census. Miss Margaret C. Klem, formerly with the staff of the Committee on the Costs of Medical Care, is conducting for the Advisory Committee a detailed examination of the methods and materials used in the construction of the indexes of retail prices and living costs. Attention is also being given to needed revisions of the budget weights used in making up the cost of living indexes. A plan for a current rotating series of budget surveys is under consideration, with the prospect that an early experimental study in Washington may be undertaken by the Bureau of Labor Statistics. Mr. Murray W. Latimer has been retained to conduct an intensive appraisal of the mechanical and technical methods, the division of labor, organization and personnel of the several bureaus responsible for the statistical work of the Department.

Three meetings of the Committee have been held, on June 9th at the offices of the Social Science Research Council in New York, and on June 27th and July 12, 1933, in Washington, D. C.

The Committee may be addressed at Room 716, Department of Labor Building, or in care of the Committee on Government Statistics, Room 5519 Commerce Building, Washington, D. C.

United States Bureau of Labor Statistics.—Dr. Isador Lubin of the research staff of the Brookings Institution of Washington, D. C., has been appointed United States Commissioner of Labor Statistics and Director of the Bureau of Labor Statistics of the Federal Department of Labor. He succeeds Ethelbert Stewart who was appointed by President Harding in August, 1920, and who resigned several months ago. Dr. Charles E. Baldwin has been Acting Commissioner since Mr. Stewart's resignation.

The Bureau's semiannual cost-of-living study was made in June and the results published in the *Monthly Labor Review* for August.

The field work in connection with the annual survey of union wage rates and the surveys of wages and working hours in the glass, iron and steel, and bituminous coal industries has been completed. Reports on the investigations of wages and hours of

labor, in 1932, of common street labor hired by municipalities, of policemen and firemen, and of workers in the motor-vehicle industry have been published in recent issues of the *Review*, as well as a summary of the wage surveys made by the Bureau from 1928 to 1932 inclusive.

Other topics which have been the subject of special study, and of articles in recent issues of the *Review*, included prison labor in the United States in 1932; technological changes and employment in the electric-lamp industry; industrial disputes in the United States from 1916 to 1932; and labor turnover in the automobile industry, 1931 and 1932.

A series of articles on land settlement in various countries, based on reports furnished by representatives of the Department of State, is being carried in the *Review*.

The quarterly compilation on labor turnover in manufacturing industries, covering the first quarter of 1933, was published in the May *Review*.

Federal Emergency Relief Administration.—A Division of Research and Statistics has been established in the newly formed Federal Emergency Relief Administration which is administering the $500,000,000 federal relief appropriation, with Dr. Corrington Gill, formerly of the Federal Employment Stabilization Board, as Director of Research. Emerson Ross and Paul Webbink are associate members of the statistical staff.

United States Bureau of Agricultural Economics.—The summary of an address by L. H. Bean, now of the Agricultural Adjustment Administration, before Section K of the American Association for Advancement of Science, in a joint program with the Econometric Society, Syracuse, New York, June 22, 1932, has been mimeographed under the title "Characteristics of Agricultural Supply and Demand Curves."

The Index Numbers of Prices Paid by Farmers for Commodities Bought, published by the Bureau of Agricultural Economics since 1928, have recently been revised on the basis of more recent and more complete data. The different subgroups of the revised index are the same as when first published in 1928, but several additional commodities were added to the index during the period 1913 to 1922, thus providing a more accurate measure of the changes in prices paid by farmers during this period of rapidly rising and falling prices. The base period of the index remains unchanged, with the years 1910 to 1914 equal to 100, but the bill of goods used as weights in the index is now representative of farmers' purchases in the years 1925 to 1929 instead of 1921 to 1925, which latter period was used when the index was first published.

"Farm Mortgage Terms and Conditions, 1932–33," mimeographed in June, 1933, presents statistical and descriptive material relating to farm mortgage financing in 1932 as represented by the operations of mortgage bankers during that year. This, the fourth annual report of this series by the Division of Agricultural Finance, indicates that new loans constituted only 10 per cent of 1932 farm real estate financing, 90 per cent being renewals; 36 per cent of outstanding loans were delinquent; 90 per cent of loans made during the year carried some provision for payment on principal during the loan term. Interest rates to borrowers averaged 6.3 per cent per annum, though rates in many areas were nominal since no funds were available for lending. Comparisons are given with data for earlier years.

On June 19 the Secretary of Agriculture announced the discontinuance, June 30, 1933, on account of the necessity for economy, of the market news service of the Bureau of Agricultural Economics. On June 28 the Secretary's office announced that

adjustments had made possible a continuance of the market news service on a greatly reduced basis. Many of the Bureau's field offices, which were concerned with collecting data for the market news service, have been closed. Where offices are maintained, substantially the same information will be gathered as in the past, but the direct distribution of the reports will be restricted.

The services of many economists, statisticians, and agricultural leaders are being utilized in connection with the Agricultural Adjustment Administration of the United States Department of Agriculture. Mr. George N. Peek, prominent in agricultural organizations and work, and Mr. Charles J. Brand of the National Fertilizer Association (formerly Chief of the Bureau of Markets) have been appointed respectively Administrator and Coadministrator. Others connected with the organization are: A. G. Black, Iowa State College; Hon. Victor A. Christgau, formerly United States Representative from Minnesota; Cully A. Cobb, Editor, Progressive Farmer and Southern Ruralist; Chester C. Davis, for many years active in various agricultural organizations in the Central West and Northwest and formerly State Commissioner of Agriculture in Montana; C. F. Sarle, Federal Farm Board; H. R. Tolley, Giannini Foundation, University of California (formerly Assistant Chief of the Bureau of Agricultural Economics); M. L. Wilson, Montana State College of Agriculture.

L. H. Bean, E. W. Gaumnitz, J. B. Hutson, and Lawrence Myers have been transferred from the Bureau of Agricultural Economics to the Agricultural Adjustment Administration.

National Occupation Conference.—Under a grant from the Carnegie Corporation of New York, the National Occupational Conference was organized early in this year to coördinate and stimulate the work of existing organizations in the field of vocational guidance. The Conference is administered by the American Association for Adult Education and has offices with the Association and the Carnegie Corporation at 522 Fifth Avenue, New York City. The executive staff consists of Dr. Franklin J. Keller, Director, who serves while on leave of absence from the New York City Board of Education, and Robert Hoppock and Raymond Fuller, Assistants to the Director.

General R. I. Rees, Assistant Vice President of the American Telephone and Telegraph Company, is chairman of the Executive Committee, which will be responsible for formulation of policies and direction of activities of the organization. Professor Donald G. Patterson of the University of Minnesota is chairman of a Technical Committee.

The purposes of the Conference include the establishment of a clearing house of information for vocational advisors and those conducting research in the occupational field, the collection and collation of studies and reports in the field, as well as the stimulation of research concerning vocational guidance, occupational trends and other economic phenomena affecting employment. In coöperation with the National Vocational Guidance Association, the Conference assumes the publication of the *Vocational Guidance Magazine*, which is now entitled *Occupation*.

The International Yearbook of Agricultural Statistics.—The International Institute of Agriculture at Rome has recently published the 1931–32 edition of the *International Yearbook of Agricultural Statistics*.

This volume of about 800 pages is the result of the most extensive and detailed inquiry made in the domain of international agricultural statistics and constitutes a

work of the greatest importance to all those who are interested in questions having a direct or indirect relation to production and commerce of agricultural products.

In the first part of the *Yearbook* are classified the figures for area and population in the years nearest to 1927 and 1931 for 208 countries. The second part is composed of a series of tables comprising for nearly 50 countries the available data concerning the uses for which the total area is employed, the apportionment of cultivated areas between the different crops, agricultural production, numbers of the different kinds of livestock and the products derived from them. In the tables constituting the third part of the volume, have been indicated for nearly 40 agricultural products, the area, production and yield per acre in each country during the five years 1923–1927 and during each of the years from 1928 to 1931.

For each kind of livestock all available figures in the different countries have been grouped for the years 1927 to 1931. A large part of the volume is devoted to statistics of the commercial movement of 43 vegetable products and 13 products of animal origin. The figures published relate to the imports and exports during the calendar years and for the cereals also during the commercial seasons.

It may be added that the tables of production and commerce not only specify details for each country but also the totals for the different continents and hemispheres and for the whole world, allowing the formation of a general idea of the changes taking place during the periods under consideration in the area under each crop, quantities harvested and the commercial movement in each product.

The part devoted to prices contains the weekly quotations of 25 agricultural products on the principal world markets for the period January, 1927, to July, 1932. In the freights section will be found the quotations for the transport of wheat, maize and rice on the most important shipping routes, and in the section reserved for fertilizers and chemical products useful in agriculture are published statistics of production, trade, consumption and prices for 15 products. In the Appendix have been brought together special chapters on the distribution of agricultural holdings according to their size and mode of tenure. The Forestry Statistics have been extended and developed and will be published in a separate volume under the title of *International Yearbook of Forestry Statistics*.

New Unemployment Survey of New Haven, Connecticut.—Opportunity for repetition of the unemployment survey of families in New Haven, Connecticut, which was made in May–June, 1931 [1] by Margaret H. Hogg of the Department of Statistics of the Russell Sage Foundation in coöperation with the Yale Institute of Human Relations, was offered in a comprehensive statistical survey of New Haven families conducted by the Institute in May–June of this year, under direction of Dr. Mildred B. Parten. Miss Hogg was invited to plan and supervise the employment-unemployment portion of this year's study.

Approximately twice as much unemployment was found this May as two years ago, the percentage of idleness from lack of work this year being 35 for men earners and 28 for women earners. In more than 14 per cent of the families all earners were idle. Idleness rates by age, by occupation, and by industry, show fairly consistent doubling over 1931, but whereas two years ago least unemployment among men was found in the early thirties, the lowest rate this year occurs in the early forties. Among professional and executive workers, and especially among people who conducted their own business, who two years ago were still relatively lightly hit, lack of work has much more than doubled.

[1] Results published in "Incidence of Work Shortage."

On methodology this second study has yielded results not possible in the first. Comparison of schedules for identical families at the two dates has thrown light on various difficulties of enumeration processes. Instances are the variability of information on age, and the difficulty of insuring that all members of a composite family are enumerated. Comparison of statements concerning both the length of present unemployment and the length of residence in the present dwelling displayed the memory's disconcerting tendency to exaggerate the length of time that the current condition has lasted.

A report on the employment situation in New Haven in May, 1933, will later be published by the Russell Sage Foundation.

The Brookings Institution.—The Institution has awarded fellowships to nine men and two women for the academic year 1933–34. Several of these awards were made coöperatively with universities, making it possible for selected graduate students and younger faculty members to study in the national capital under the auspices of the Brookings Institution. The subjects on which the new fellows will concentrate range from "Foreign Exchange Control" to "The Attitude of the American Clergy from 1890 to 1900 toward Imperialism, and the Effect These Men Had on Public Opinion in the United States." Nine of the fellows are of American birth, one is Canadian, and one German. The list of successful applicants is as follows: Charles A. Annis, Cornell University; Jeannette L. Berger, Radcliffe College; Charles J. Coe, Brown University; Henry H. Edmiston, Yale University; Lee S. Greene, University of Wisconsin; James C. Nelson, University of Virginia; Helen C. Sands, Radcliffe College; Dr. Rainer W. Schickele, Iowa State College; Edward C. Simmons, Ohio State University; Leroy D. Stinebower, University of Chicago; John H. Thurston, Harvard University.

Paul T. David, Brookings fellow 1932–33, is serving with the Tennessee Valley Authority. Robert Connery, Brookings fellow 1932–33, has been appointed instructor in the Extension Division of Columbia University.

Y. S. Leong, a former Brookings fellow, has completed work for the doctorate at Columbia, and his thesis—"Silver: An Analysis of Factors Affecting Its Price," has been published by the Institute of Economics. Dr. Leong has accepted a position with the National Recovery Administration, Division of Research and Planning.

The Public Administration Clearing House, under the direction of Louis Brownlow, is opening a Washington office at 734 Jackson Place, with Lewis Meriam as the Washington manager.

Taylor G. Addison is serving as assistant director in charge of the Washington, D. C., administrative office of the United States Employment Service of the Department of Labor.

Benjamin P. Whitaker has been appointed director of research of a special tax commission for Connecticut.

Henry P. Seidemann is coöperating with the Director of the Budget in a revision of the itemization of accounts and appropriations.

Fred W. Powell is serving on a temporary appointment as one of the four experts who will coöperate with the Federal Coördinator of Transportation.

President Roosevelt has appointed Dr. Isador Lubin to the post of Commissioner of Labor Statistics; and the Federal Public Works Administration has appointed Dr. Lubin chairman of its Labor Policies Board.

Max Sasuly has completed for the Institute of Economics his study entitled "Trend Analysis of Statistics: Theory and Technique," and has accepted a position

as senior statistician with the National Recovery Administration, Division of Research and Planning.

Dr. Frieda Baird, a former Brookings fellow and staff member of the Institute of Economics has accepted a position with the Farm Credit Administration.

Lewis L. Lorwin was selected as a delegate by the American Council of Pacific Relations to attend the Fifth International Conference of the Institute, held in Banff, Canada, from August 14 to August 28. This conference was devoted to an examination of conflict and control in the Far East.

PERSONALS

Dr. Stuart A. Rice, President of the American Statistical Association and formerly professor of sociology and statistics at the University of Pennsylvania, has been appointed Assistant Director of the Census. This was formerly a temporary office, created for the duration of the decennial census, but it is now made permanent.

There has been established in the Bureau of the Census a division of statistical research to which Dr. Joseph A. Hill has been assigned as Chief Statistician. Dr. Hill, President of the American Statistical Association in 1919, has been connected with the Bureau of the Census since 1899. He was appointed Chief Statistician in 1909 and in 1921 was made Assistant Director for the Fourteenth Census. He held the same position during the Fifteenth Census.

Mr. Z. R. Pettet, formerly agricultural statistician in the Department of Agriculture and later in the Bureau of the Census during the Fifteenth Census period, has been appointed Chief Statistician for the Division of Agriculture.

Dr. Leo Wolman of Columbia University and the Amalgamated Clothing Workers of America, and Review Editor of our JOURNAL, has been appointed a member of the Advisory Board representing labor, which is assisting in the administration of the National Recovery Act.

Professor John H. Williams was graduated from Brown University and took his doctor's degree in economics at Harvard in 1919. After teaching experience at Brown University, Princeton University and Northwestern University, he became professor of economics at Harvard. In addition to his academic work, Professor Williams, from time to time, has carried on other undertakings, including service as assistant editor of the *Harvard Review of Economic Statistics*, and the organization and development of the annual studies of the balance of payments of the United States now published by the Department of Commerce. Last autumn, Professor Williams, with Dr. E. E. Day, was appointed to represent this country upon the Committee of Experts which prepared the agenda for the forthcoming World Economic Conference.

Professor Henry Schultz, of the University of Chicago, who has been appointed to a fellowship of the Guggenheim Foundation, will spend the year 1933–34 in Europe, conducting studies in the field of mathematical and statistical economics.

Dr. C. Luther Fry, formerly of The Institute for Social and Religious Research, has accepted the appointment as head of a new department of sociology at the University of Rochester. It is hoped that the program of the department will include significant developments in social research.

Dr. Paul R. Rider of Washington University, St. Louis, has been engaged by the United States Business Trends Corporation of Columbus for some consulting statistical work. He spent the summer in Columbus.

The Foundation for the Advancement of the Social Sciences of the University of Denver sent Dr. A. D. H. Kaplan, professor of economics, as an observer to the World Monetary and Economic Conference which opened in London on June 12. He represented Colorado and the Rocky Mountain region.

Professor Hornell Hart has resigned the chair of social economics at Bryn Mawr College to become professor of social ethics at the Hartford Theological Seminary at Hartford, Connecticut.

J. Herbert Leighton, recently assistant to the president of the Bush Terminal Company, and formerly with the American Telephone and Telegraph Company, is now associated with the treasury department of the New York Life Insurance Company, where he is conducting statistical research concerning railroad organization.

John Dunphy will join the faculty of the University of Denver in September, 1933, as an instructor in the economics department. He formerly taught at Regis College in Denver, and the College of St. Teresa in Winona, Minnesota.

Charles B. Davenport and Merle P. Ekas are planning a revision of *Statistical Methods* and should be glad to receive any forms, schedules, accounts of methods of institutes, and of apparatus for inclusion in the book. Address Charles B. Davenport, Cold Spring Harbor, New York.

ADDITIONAL COMMITTEE APPOINTMENTS

Committee on Calendar Reform

M. B. Folsom, *Chairman*
S. L. Andrew
H. S. Carter
W. J. Donald
E. D. Durand
A. H. Hedrich
C. F. Marvin
R. P. Towne

Committee on Government Statistics and Information Services

Edmund E. Day, *Chairman*
Stuart A. Rice, *Acting Chairman*
Meredith B. Givens, *Executive Secretary*
Morris A. Copeland
William L. Crum
Bryce M. Stewart
Willard L. Thorp

Advisory Committee to the Secretary of Labor (additional appointment)

Murray W. Latimer, *Secretary*

Committee to Welcome Delegates to the International Statistical Institute upon Their Arrival in New York

Haven Emerson, *Chairman*
Robert E. Chaddock
Leon Henderson
Willford I. King
Edgar Sydenstricker
Walter F. Willcox

Committee on Chapter Relationships

John L. Sweet, *Chairman*
Howard G. Brunsman
Roswell F. Phelps
Edward A. Stephen
Clarence Tolg

MEMBERS ADDED SINCE JUNE, 1933

Berglund, Winifred V., Graduate Student, Northwestern University, Evanston, Illinois

Borgwald, John H., Ohio Bell Telephone Company, 750 Huron Road, Room 1501, Cleveland, Ohio

Brodie, Israel B., Lawyer, 2160 Graybar Building, New York City

Cramer, Edison H., Instructor and Assistant Secretary of the Bureau of Business and Government Research, University of Colorado, Boulder, Colorado

Davis, Lawrence M., Mail Order Sales Department, Montgomery Ward and Company, Chicago, Illinois

Fisher, Waldo E., Industrial Research Department, University of Pennsylvania, 3440 Walnut Street, Philadelphia, Pennsylvania

Gere, Francis M., Analyst, E. L. Phillips and Company, 50 Church Street, New York City

Gilaryi, Lawrence, Securities Analyst, Fitch Publishing Company, 138 Pearl Street, New York City

Gilbert, Jack J., Analyst, 1 North State Street, Chicago, Illinois

Iglauer, Jay, Vice-President, Treasurer and Controller, The Halle Brothers Company, 1228 Euclid Avenue, Cleveland, Ohio

Ingraham, Olin, Professor, Massachusetts Institute of Technology, Cambridge, Massachusetts

Marvin, Dr. Charles F., Meteorological and Solar Statistics, U. S. Weather Bureau, Washington, D. C.

Miller, Raymond F., Southern Pacific Company, Room 2117, 165 Broadway, New York City

Ochs, Jack, Student, School of Commerce, New York University, 236 Wooster Street, New York City

Rose, Raymond, 1716 Caton Avenue, Brooklyn, New York

Schumpeter, Dr. Joseph A., Harvard University, Cambridge, Massachusetts

Seidl, Julius C., Graduate Student, Fordham University, Woolworth Building, New York City

Shailer, Frank A., Actuary, 393 Seventh Avenue, New York City

Sheng, T., Vice-Chairman of National Tariff Commission, Customs Building, Hankow Road, Shanghai, China

Sutherland, Dr. Edwin H., Criminal Statistics, University of Chicago, Chicago, Illinois

Witmer, Dr. Helen L., Smith College, School for Social Work, Northampton, Massachusetts

REVIEWS

Recent Social Trends in United States. Report of the President's Research Committee on Social Trends. New York: McGraw-Hill and Company. 1933. 2 Vols., 1568 pp.

These two volumes are truly a cyclopedia for social scientists drawing upon the material contained in the thirteen books being published by the same Committee, the books on monetary and financial problems of the National Bureau of Economic Research and the many detailed investigations of individuals. It is not surprising that the investigation should be made at the request of an engineer, ex-President Hoover, for an engineer requires all of the available facts and interpretations as the basis for his own action. The series of reports dating back to 1921, of which this and *Recent Economic Changes* are the culmination, may be counted as a great contribution by him to social science. This contribution stands even though a great national emergency forced him to act so quickly and experimentally that it was impossible to await the slow process of economic and social investigation.

The volumes are essentially clear and coherent summaries of the enormous output of materials from investigations previously made, though it also includes some important materials not previously published. All of this material was digested, summarized and coördinated by the forty authors of the volumes, all of whom are recognized authorities for several years past in their own special fields.

The task of giving to the layman a short, clear, comprehensive picture of the most important related social trends in America is immense and we are greatly indebted to the distinguished Committee as well as the specific collaborators. The material compiled in the thirteen separate monographs is combined with other data and condensed into twenty-nine reports of about fifty pages each on the important fields of social activity investigated. These summaries are then brought together into something like a unified whole in the seventy pages of "findings" of the Committee. This summary will be first read by the layman for a bird's eye view of the entire field embracing both the interrelationships between the parts and the bold outlines of each field investigated. The more careful student will explore further into each field of his interest.

Such an interrelationship is exceedingly difficult to picture and the ramifications are so vast and the designation of "fields" so arbitrary that one cannot expect the "findings" to picture fully all of social activity. It appears that even with these limitations more could be done to suggest the important ways in which trends noted in one field affect others. Although this has been portrayed sufficiently well to be suggestive it still is true that the volumes stand primarily as a compendium of valuable material rather than as a unified picture.

The individual authors and especially the members of the Committee in charge of the work have in other places given us insight and understanding of the fields

of their specialities. An investigation under the injunction to present a "complete, impartial examination of the facts" is not the place to look for such insights. The Committee frankly recognizes that the trends "run forward into the series of questions raised but not answered." And this is proper for "nothing short of the combined intelligence of the nation can cope with the predicaments." For the work merely presents the raw material for actual social decision and scientific pioneering. It summarizes the body of facts already available. It remains for the social engineer, the social statesman, and in fact for any group leader to make use of the data and to convert interpretation of past trends into present action and social purpose for the future. If these volumes have been criticized as trite, it is because the critic has misunderstood the function of the Committee. An individual may yield new interpretations of data based upon his insights and his scales of values; a group may express a purpose through the remolding of the social data; but a Committee can merely present either with the raw data.

When a trend has been studied, it is almost inevitable that the question shall be raised whether the trend can be used as a basis for forecasting by extrapolation. Can we guess social activities into the future on the basis of such investigations? The long sweep of many of the trends noted and the breadth of the changes suggest the likelihood of their continuance. Yet the very interrelationship suggested by the Committee makes extended scientific predictions impossible. So the reports suggest an understanding of present problems without implying that the very handling of those problems would not change the character of the trends. The Committee could not be expected to know of the revolutionary changes in politic-economic organizations that are occurring since its study was completed. It could and did note that the lag between the trends it has investigated presented the problems to the country in an acute form.

The concept of an equilibrium between rates of change in social trends has been well exploited in the two volumes. The strains in a social structure which appear because some aspects of community life more readily adapt themselves to new conditions than do others help to suggest the social problems that are thus presented. The concept was used as a mental tool for finding and interpreting the problem rather than depended upon for a solution. The solutions must come from the man of social insight and from those who have power to define public purpose.

In general the Committee noted the general tendency for both industry and government to expand their activities and extend the range of their operations, while both the church and the family have declined in influence. In somewhat more detail, the Committee noted the social problems resulting from: the greater increase of physical production than consuming power, the increase in fixed investment and the staple labor supply by declining public preference for the railroads, the greater increase in machinery than in durable consumers' goods and the increase in consumer staple articles at a much smaller rate than either the intensifying industrial concentration at the same time as a decline in the strength of labor organizations, increasing sales pressure along with an increas-

ing dependence of the consumer on the market and a decreasing knowledge of the quality of commodities, an enlarging agricultural productivity and a diminishing rate of growth in the demand for agricultural products, an increase in the broader capacities of individuals but a slow change in educational methods and controls, a rapid increase in the need of governmental supervision and slow change in political institutions. There are many more which the Committee notes, and still others which it implies when it indicates it has not handled the issues that center around the cause of the current depression, basic economic changes, peace and war, international relations and the development of knowledge in the social sciences.

From the combined wealth of materials assembled together by leading students in their respective fields no student of social relations can fail to draw a great deal of data and useful interpretations for his own understanding.

John R. Commons

University of Wisconsin

World Social Economic Planning. M. L. Fleddérus, Editor. The Hague: International Industrial Relations Institute. 1932. 2 Vols., lxiii, 935 pp.

This is the second publication resulting from the World Social Economic Congress held at Amsterdam in August, 1931, under the auspices of the Industrial Relations Institute, and consists of the papers and discussions of the conference, including an interpretation by Dr. Max Lazard of the previously-printed reports on actual conditions of unemployment in the different countries. Papers and discussions are in French, German and English; and the principal contributions, in whichever language presented, are accompanied by full translations or synopses in the other two tongues. Miss van Kleck, the Chairman of the Program Committee, contributes a review and summary of the entire conference.

The conference started with no previous agreement as to the meaning of planning, and the materials cover many variants, both as to scope and as to the degree of central authority involved. As was to be expected, the conference reached no agreement, unless it were on the seriousness of the problem, as to the desirability of some change in world policies and the topics on which further research would be desirable. There was, however, virtual unanimity on the need of a greater measure of concerted action. It was unanimity broken only by the lone voice of Dr. Benham, who mildly suggested that if we tried the experiment of economic liberty (as we have not done for some decades) it might be found to work better than the nondescript policies which have actually been in force.

The materials of the proceedings may be roughly divided into three groups. First come surveys of existing economic conditions, including Dr. Lazard's survey of causes of unemployment and Dr. Neurath's assessment of developments and capacities of production. Second come existing forms of planned or concerted action, including the Soviet form, and various forms of limited scope or objective, existing within the framework of so-called "capitalist" society.

Here belong Dr. Haan's treatment of rationalization; Dr. Palyi's succinct account of the failure of international industrial combines to achieve stabilization; Professor Chamberlain's study of the development of the multilateral treaty toward a form of international government; Albert Thomas' plea for maintenance of labor standards, to the advancement of which the International Labor Organization is dedicated; and other interesting contributions. Third come proposals for some form of planning not now in existence, or philosophies driving toward some new goal. These include detailed proposals such as Dr. Broda's suggested changes in the constitution of the League of Nations, or general concepts such as Dr. Lorwin's definition of social-progressive planning as distinct from other types. Dr. Person's treatment of scientific management seems to belong with this group, because the whole burden and emphasis is on the logical necessity with which the application of the principles of scientific management has broadened step by step until the inevitable next step is the coördination of the business system as a whole.

The discussion, quite naturally, leaves unsettled the central question of planning: namely, can we secure sufficient concerted action to bring about the main ends of industrial stabilization and a high general standard of living without going the whole length of socialism and substituting collective for private ownership? The Soviet representatives say no, and Dr. Heinz Ludwig calls Dr. Person a Socialist who has not drawn the consequences of his principles. Dr. Person, on the other hand, speaks of himself as interested in the possibilities of evolutionary development in which, as he clearly implies, authority would follow function wherever new functions develop rather than remaining vested in formal and traditional ownership. We know that functions traditionally bound up with ownership are being redistributed without formal transfer of ownership itself. Whether this process can go far enough for the main ends in view—that no one can tell us. But it seems clear that the character of the business unit must change greatly before voluntary coöperation of such units will set up an authority that will actually keep social forces at work to satisfy social needs, rather than trying to stabilize profits and failing as international cartels have failed.

One achievement of the conference was to bring official representatives of the Soviet planning organization to discuss their planning system on the same platform with non-communists. The result is highly enlightening, despite the inevitable color of propaganda, and the baffling inconclusiveness of most of the statistics cited. (This last Dr. Lorwin points out with the utmost good humor.) The usefulness of the conference might possibly have been increased by the inclusion of the more socially-minded forms of American business plans for planning, as represented by the proposals of Mr. Swope and of the National Chamber of Commerce. A serious attempt to gauge how far these really differ from the "social-progressive" type might have brought forth something of value.

If the reviewer were to attempt to assess the value of this conference as a whole, his judgment would inevitably be subjective. It would express his conviction that the irresistible trend of events is toward more correlation and con-

certed control; and that, this being the case, it is of vital importance to give representation to the views of those who think of the economic system as a whole, and basically as an instrument for furnishing the necessities of life and means of welfare for the whole people, and whose ideas of planned stability will run in these terms, rather than leaving the field to those who see it in terms limited to the socially futile particularist machinery of trade barriers, industrial combinations, valorization and the like. For a more objective verdict the world must wait, perhaps for generations, to see if the trends of history bear out our present impressions. But the action that will determine these trends cannot wait for this final verdict.

J. M. CLARK

Columbia University

The Economic Results of Prohibition, by Clark Warburton. New York: Columbia University Press. (Studies in History, Economics, and Public Law No. 379.) 1932. 273 pp.

Dr. Warburton's study is an analysis, largely statistical, of the available facts bearing on the arguments for and against prohibition. A statistical table appears, roughly speaking, on every other page. The author resists the temptation to settle the prohibition controversy by setting forth his own opinions and prejudices. He pushes his analysis as far as the facts and statistical methods permit: the controversies among people for whom facts have no meaning are left out. For example, he does not attempt to say what the economic results of prohibition would have been if prohibition had prohibited. He is fully conscious of the great difficulties of an analysis limited to the facts, because the facts of the era of attempted prohibition are the resultants of all the many forces at work in that lively period. In general, Dr. Warburton's method is to determine a pre-war trend or correlation and observe the changes since prohibition. If this method is not always fully conclusive, the answer is that there are no better methods and that an approximate answer is better than none. Insufficient data do not permit the measurement of the effects of prohibition on industrial productivity, absenteeism, and accidents.

Dr. Warburton's conclusions appear most firmly established where he deals with the expenditures upon and consumption of alcoholic beverages. His conclusions on the effects upon the farmer and upon the taxation of the rich appear most questionable, even in their qualified form. The lost market to the farmers was more than made up by the increased sales of milk, but the connection between the sales of alcoholic beverages and the sales of milk is open to question. The distribution of the burden of public expenditures is so much a question of opinion about social justice that the reviewer doubts that the loss of public revenue from the beverages added to the burdens of the rich. On these points, the reviewer prefers a more skeptical or agnostic position.

Dr. Warburton's book is both encouraging and chastening to the social scientist. We are much better off for such a book—how much has been rescued

from sterile declamation! And yet—how much is left in the realm of the unknown and unknowable even by such a vigorous and painstaking study!

R. S. MERIAM

Harvard Business School

The National Income, 1924–1931, by Colin Clark. London: Macmillan and Company. 1932. 167 pp.

Mr. Clark first compounds the national income total for the United Kingdom for 1924 and 1928 from data on assessed incomes, estimates of non-wage incomes exempt from tax, and an estimate of wages. With the help of tax data and various indexes, estimates are then made for the years 1926 through 1931. The totals thus arrived at are distributed among various factors of production. Some notion of the personal distribution of incomes by size is given for 1924 and 1928, although the data do not permit any apportionment at the lower end of the income scale. The real earnings per occupied person and per family are computed for 1924 and 1928–31. The production side of income is studied in detail for 1924 and 1927–31. For the same years, national income is analyzed on the expenditure side, as between consumption and investment. Price indexes for various groups of productive services are presented for the years 1924–31. And finally, Mr. Clark presents an analysis of prices, costs, investment and saving, utilizing Mr. Keynes' equation and definitions.

The book is thus a veritable mine of information in the field. Anyone not thoroughly familiar with British statistics finds it next to impossible to evaluate the reliability of the numerous measures presented. It is obvious, however, from an attentive reading that there is a striking contrast in trustworthiness between the measures of the different factors, a natural corollary of the somewhat chaotic state of British statistics which is made the subject of an eloquent complaint in the introduction. One might quarrel with the author's decision to exclude from national income internal payments on government debt, although there is eminent precedent for it and the figures in question are presented. A more serious criticism relates to the character of the discussion which suffers from faults all too common in the literature on national income. The text is a mixture of brief notes on the methods and sources employed, with a few comments on the significance of the results. The description of methods and sources is in many cases all too scanty to be of use to any interested technician, this being especially true of the estimates covering the production side of income. But it is too comprehensive for the non-technical reader who is interested in the results and their interpretation. It might have been more advisable to carry the explanation of methods into a separate part of the book and organize the description of sources somewhat more systematically, to permit convenient reference.

All in all, it is an assiduous, and often brilliant, attempt to fit a vast body of heterogeneous data into a consistent picture of a country's national income over a disturbed period. Mr. Clark covers a much wider canvass than the earlier investigators in the field (Bowley, Stamp, and Flux) especially in the complete-

ness with which he traces the flow of income from its industrial sources to the channels of expenditure and saving. And if at some stages of the inquiry, data are strained perilously close to the tolerance point, the effort should nevertheless be accorded full credit. It is an effective stimulus toward further analysis and enrichment of available information as well as toward quantitative testing of some widely current economic generalizations.

SIMON KUZNETS

National Bureau of Economic Research

A Decade of Corporate Net Incomes, 1920 to 1929, by S. H. Nerlove. Chicago: The University of Chicago Press. 1932. ix, 76 pp.

This short monograph consists of ten chapters on the "size and behavior" of corporate "gross" and "net incomes" in the United States over the period 1920–29. The statistical material rests mainly on data published by the Bureau of Internal Revenue in its annual *Statistics of Income*. The analyses run principally in terms of "all corporations," that is, all manufacturing, trading, financial, construction, utility and other industrial groups are treated as a unit, although for four broad industrial divisions (mining, manufacturing, construction, trade) some separate figures are given.

The statistical findings indicate that the "gross" income of all corporations increased from about 122 billion dollars in 1920 to 159 billion in 1929. "Gross" income, as the author uses the term, is a hybrid figure which merges the sales of manufacturing corporations with gross profits from the sales of stocks, bonds, real estate, etc. obtained by manufacturing, financial and other types of corporations. Accordingly, the reviewer can scarcely agree that "annual changes in corporate 'gross' incomes offer a measure of fluctuations in the value of corporate goods and services exchanged" (p. 4) . . . which "is reliable" (p. 5), unless one includes the changing prices and volume of corporate securities in his definition of "goods and services exchanged." It may be that Professor Nerlove has made allowance for this factor of sheer security inflation—particularly as reflected in the "gross" of various financial corporations as against manufacturing, trading and other corporations—but none appears in the discussion. In its absence, however, changes in "gross" from one year to the next are not conclusive as to changes in goods and services.

Corporate net income, Professor Nerlove finds, grew from about six billion in 1920 to nearly ten billion in 1929. Annual changes in net income are found to correlate with both changes in the physical volume of production and the wholesale commodity price level, especially with the former. Three chapters analyze the course of net incomes and the relation of "net" to "gross." Other short chapters treat of net incomes and invested capital, the compensation of officers, Federal income taxes, and the reinvestment of income.

The study seems more competent statistically than interpretatively. It is, for example, said (p. 38) that all corporations for the whole period 1920–29 averaged net earnings of 6.6 per cent upon invested capital (which is estimated) the

annual figure varying between 1 and about 8.3 per cent. A note then remarks that this "seems to justify the 'rule-of-thumb' figure often used by rate-making bodies, i.e., 6–8 per cent." Hardly! The data which average 6.6 per cent are for all corporations in the country—large, small, profitable, unprofitable—and in all industries. Some are subject to severe competition, some have virtual monopolies. To say that the *average* return for several hundred thousand heterogeneous enterprises of all types from small closely held trading concerns to the General Motors Corporation *justifies* the prevailing practice of rate-making bodies is scarcely defensible, even in a footnote! In the text of the same chapter, and in connection with the same figure of 6.6 per cent, appears a similarly quick conclusion. It is stated that "the yield on high-grade bonds during the same period averages approximately 4.5 per cent. . . . The payment for the risk involved in furnishing capital to industry on the basis of equity contracts instead of fixed income contracts was, then, on the average approximately 2 per cent annually" (p. 39). The bond yield used, it shortly appears, is Frederick R. Macaulay's index of rails (National Bureau of Economic Research). To hold that the discrepancy between the yield of *high-grade, railroad* bonds and an *average return* of 6.6 per cent on the estimated capital investment of all kinds of industries and corporations indicates the payment for risk involved by "equity-contracts" instead of fixed "income-contracts" is far too easy a disposal of the vexing question of interest *versus* profits. Many of the corporations included in this average figure have no bond issues at all; indeed some entire industries have scarcely any. To lump all corporations together and then reason from a highly abstract average result ignores too many considerations. Professor Nerlove in one or two places cites Hayek's *Prices and Production*. He would have done well to recall Hayek's criticism of the use of general average figures for interpretative purposes.

But it is easier to compile and analyze than to interpret; of this the reviewer is only too well aware. If, on the whole, Professor Nerlove's essays at interpretation have been unfortunate, his task of compilation and analysis has been well performed; and his monograph none the less constitutes a worth-while contribution to an increasingly important field.

RALPH C. EPSTEIN

University of Buffalo

Trusteeship of American Endowments With Comparative Analyses of the Investment Experience of Leading Universities, by Wood, Struthers and Company. New York: The Macmillan Company. 1932. xiv, 156 pp.

The question of management of investment funds belonging to American universities and other endowed institutions has for a long time past presented one of the most interesting problems in the field of trusteeship. This problem has become acute with endowed as it has with financial, institutions and, indeed, with all trustees since the opening of the depression. Messrs. Wood, Struthers and Company, experienced investment specialists, have prepared a careful study

of the conditions which exist among endowed institutions in the United States, "in the hope that it will be definitely helpful to individual and corporate Trustees, and to all those Trustees of religious bodies, educational institutions, hospitals, foundations, organized charities, and other cultural and humanitarian organizations for which the lengthening depression has created serious or desperate situations."

The outcome of the study shows great variation in experience but the authors state that they have portrayed investment practices which have been detrimental with the same fidelity as those which have been favorable, the outcome being a rather unusual survey of American endowment finances hardly to be duplicated elsewhere. The book closes with an actual list of bonds and stocks held by five or more universities or colleges designed to show the performance of institutional investments, while a reference to the text shows in each case the extent to which these securities have actually proven a satisfactory reliance. Needless to say, the general showing that results from the text is not very encouraging, and shows why it is that many institutions are finding it currently necessary to reduce salaries or staffs, or both. The authors close their treatment with the remark that "In practice no two Boards of Trustees seem to pursue the same methods in handling their funds . . . though fundamental rules governing the investment and management of permanent funds change but little, the ideal investment policy for general use has not yet been framed." Nevertheless "a consistent investment policy, adapted to the specific purposes of the endowment, is an indispensable preliminary to the successful building of any permanent fund." The inference to be drawn from these remarks is that although general principles of investment are well enough known, their application in every given case is a matter requiring expert assistance.

Perhaps the most serious criticism to be made upon this study is the fact that it is as highly specific and detailed as it is, yet offers so little in the way of general advice and suggestion. It would require a fairly qualified student of investment banking to read it with more than superficial instruction. Nevertheless, it should prove materially helpful to institutional investors as a record of the policies of their contemporaries. There is much in it that may serve as the corrective material upon which to found an improved investment policy for use by those who in the past have been disposed to work without any very positive guiding principle.

H. PARKER WILLIS

Columbia University

Communication Agencies and Social Life, by Malcolm M. Willey and Stuart A. Rice. McGraw-Hill Book Company. 1933. 214 pp.

This study is one of a series of monographs published under the direction of The President's Research Commission on Social Trends. Its scope is confined to the development and utilization of the media of transportation and communication, their interrelationships and their social effects. The monograph is in

three main parts. The first deals with agencies of transportation—railroads, highways, water and air—and their utilization in the actual movement of persons; the second with "point to point" communication—the postal service and several forms of service by wire or wireless—providing indirect or mediated contacts between individuals; and the third part discusses the agencies of mass impression—newspapers and periodicals, motion pictures and radio broadcasting—whereby from a single source many separate individuals are stimulated simultaneously.

The purpose of the volume is to trace the changes in the utilization of each, how a change in one affects others, and how human habits are influenced thereby. The main thesis is that, in terms of transportation and communication, the distance between coasts has shrunk to a degree beyond the imagination of our forefathers. Such shrinkage necessitates social adaptations throughout the entire country. In the economic world it brings problems of organization, both in production and distribution. The localized market has expanded to embrace a continent. The urge to large-scale production, mergers and consolidations cannot be understood fully unless they are related to the expansion of the facilities of transportation and communication. Similarly, in the field of government, centralization of functions and the declining importance of small, localized units of administration are related to the development of the contemporary communication network.

The discussion throughout is almost exclusively from the sociological viewpoint. Little attention is paid to operating technique; the emphasis is placed upon the trends in results. In so far as transportation is concerned no consideration is given to the movement of commodities although it is obvious that there is sociological import also in improvements in the speed, regularity, adequacy and economy of freight transportation.

In the section relating to passenger transportation by railroad, the substantial decline since 1920 is attributed mainly to the intrusion of a new agency—the motor car—into the field theretofore largely monopolized by the older agency, and the suggestion is made that correlation between the two is socially desirable. As to electric railways, we are reminded of the period early in the century when the trolley car served for pleasure trips as well as necessity travel. The pleasure function disappeared with the advent of the automobile. The number of passengers carried by electric railways in large centers of population has not fallen off but the total for all communities, influenced by the substitution of the bus in smaller communities, shows a substantial decline since 1922.

The social significance of the automobile is emphasized by the statement that probably no innovation of such far-reaching importance had ever before been disseminated with such great rapidity. The importance of the automobile as a commercial passenger transportation agency is greatly transcended by its importance as an agency of private passenger transportation. The freedom of control within the individual and the almost unlimited potential mobility of the automobile have revolutionized traveling habits. Local communities are being more closely knit into regional urban areas and man's personal contacts in remote

communities have been multiplied enormously. The automobile has rendered local administration of highways practically obsolete and has brought about state-wide and national highway planning under centralized state and federal control. Improved highways have been made necessary by the motor vehicle and the better roads have increased the use of such vehicles.

An analysis of the available statistics leads the authors to conclude that longer journeys by more people are now made with relatively greater frequency than ever before, with an even greater intensification of mobility within circumscribed local areas. Contacts within the community are multiplied out of proportion to contacts at a distance. The more frequent distant contacts may be destructive of provincialism, but the still more intensified local contacts may serve to foster it.

Classified as "point to point" communication are the postal service and services by wire or wireless. Attention is called to the fact that the postal services, notably through the development of rural free delivery, have been brought to the doors of a continuously larger portion of the population. The data reveal in general an increasing frequency of contact between individuals. The growth and improvement in telegraph service have been overshadowed by the extension and more general use of the telephone. Of especial interest are the statistics which reveal the trend in yearly telephone calls per capita, the division of such calls between local and long-distance, and the conjectural observations on social effects. One of these is that the more frequent contact tends toward brevity and impersonality and may result in loss of those values that inhere in more intimate, leisurely and protracted personal discussion. Devices that permit speed in turn induce it.

Under the heading of agencies of mass impression are presented and analyzed comprehensive statistical data relating to the number, circulation, ownership and character of newspapers and periodicals, and the volume of advertising matter; the number of motion picture theaters and the nature of the pictures; and the development of radio broadcasting, the ownership of receiving sets, and the organization of the chain broadcasting companies. Social mechanisms now exist whereby it is possible to impress the people of an entire country simultaneously, involving far-reaching effects upon social attitudes and behavior. Such a communication system is both terrifying and inspiring in its potentialities —terrifying because of the possibilities it opens for the accomplishment of selfish ends and inspiring for its potentialities of social self-control.

The residual impression gained from the survey is of individuals at the focal points of interrelated social stimuli that are continuously impinging upon them from the world about. During thirty years the number and intensity of these stimuli have increased, the boundaries within which they arose have expanded, while the speed with which they were transmitted has accelerated. Among these interwoven stimuli there appear to be two contradictory tendencies. One is the reinforcement of community patterns of attitude and behavior, resulting from multiplication of contacts with others in the same community. The second is standardization over wider national and international regions. The first ten-

dency makes for the perpetuation and intensification of localism. The second appears to undermine localism and obviously does so in certain externals. The conclusion of the authors is that both of these opposing factors are concurrently effective because they are selective in their application. An increase in overt standardization may be accomplished by retention of inward differences.

Professors Willey and Rice have performed their task with skill, and have produced an authoritative, interesting and thought-provoking volume. The book is a real contribution to the scant literature in the special field of sociological implications of transportation and communication.

WILLIAM J. CUNNINGHAM

Harvard University

The Distribution of Consumable Goods, by Dorothy Braithwaite and S. P. Dobbs. London: George Routledge and Sons, Ltd. 1932. xiii, 304 pp.
The Consumer, His Nature and Changing Habits, by Walter B. Pitkin. New York: McGraw-Hill Book Company. 1932. xiii, 421 pp.

These two books have little in common beyond the superficial similarity suggested by their titles. They are strikingly different in style, content and scholarly character. If the first is more of a tribute to British scholarship than the second to American, it may be partially due to the fact that "consumable goods" lend themselves to study as "consumers" do not. In fact so elusive is the "nature of consumers" that the favorite method of approach is through the study of the goods they use. Unfortunately this method as hitherto applied throws more light upon the goods than upon their users.

The Distribution of Consumable Goods is also quite unlike the majority of American books on marketing. The latter tend to concentrate on the description of actual trade practice and organization. Mrs. Braithwaite's intention, however, was not so much to fill a gap in descriptive economics as "to examine in the light of accepted economic principles the structure and functions of the distributive machine." Her work therefore with its distinctly economic approach should be especially valuable and stimulating to American students of marketing.

The inquiry represented by this book was begun by Mrs. Braithwaite while she was a student of economics at Cambridge. After her untimely death in 1928, Mr. S. P. Dobbs who also received his economic training at Cambridge was asked to complete the manuscript and prepare it for publication. Those who had noted Mrs. Braithwaite's article "The Economic Effects of Advertising" in the *Economic Journal* for March, 1928, will be glad to find it as Chapter VII of this book. Chapter III entitled "Information" serves as a foundation for Mrs. Braithwaite's thesis that advertising is on the whole injurious to the community.

Mr. Pitkin warns the economist, the business man and the psychologist that his book will bewilder them. He says also with truth that they will even find much in it that seems irrelevant and perhaps absurd. The lay reader may

however, he says, dip into it with neither fear nor confusion. But even the lay reader will be disappointed if he hopes to learn here of the "nature" of the consumer, that is, the nature of his wants and their relationships. Mr. Pitkin, as many others, finds it easier to discuss "Factors Limiting Volume Consumption," and "Classes of Consumers," Books III and IV, occupying three-fifths of the total space. Other sections are "How Wealth Accumulates," "The Web of Life," "The War between Maker and User."

The best parts of the book in the reviewer's opinion are the shrewd and penetrating comments that are found scattered through its pages. For example, "Most evils can be warded off only through stiff teamwork, but most good things can be sought and enjoyed only according to individual interest and taste." (Page 401.) A sample of the worst is the following: "The average mark-up on goods by retailers is 25 per cent in the United States; and retail purchasers take about half of all personal incomes in the country. On the basis of a fairly good year, then, when incomes would run up toward $75,000,000,000, we would be paying out $9,375,000,000 for the cost of retail distribution. . . . Most of this vast sum is, in strictly economic accounting, sheer waste. And the fault lies less with the retailer than with woman the economic imbecile who buys from him. This has often been shown without making the slightest impression on women, who never read economic studies and never would practice their teachings, even if they did read them." (Page 281.)

Hazel Kyrk

University of Chicago

Neighborhood Distribution and Consumption of Meat in Pittsburgh, by John H. Cover. Chicago: University of Chicago Press. 1932. 228 pp.

This is an intensive study of the merchandising of meat in representative neighborhood stores in Pittsburgh. The influence of income, size of family, racial and religious tradition, occupation, other food purchases, shopping methods and the rationality of purchasers are among the outstanding purposes sought. Data are presented on the percentage which shop by telephone, pay cash, have the meat trimmed, inspect the scales. The exact proportion of meat in the food budgets in the different neighborhoods, the cuts purchased and typical menus are presented.

While the book may be of some practical value to meat merchants, it arrives at conclusions which will not startle those who are aware that poor people must buy inexpensive cuts, that rich people have greater variety, that most people are not thoroughgoing rational calculators, that many small merchants use old-fashioned methods, that some shops are clean and others are not. The most important question raised by the book is the practical or methodological value of elaborate surveys for unimportant ends.

Gustav Peck

The Principles of Financial and Statistical Mathematics, by Maximilian Philip. New York: Prentice-Hall. 1932. xx, 406 pp.

Previous books on the Mathematics of Finance have confined themselves to the application of mathematics to business problems and contained no topics of a solely mathematical character save the usual chapters—either in the text or in the appendix—on logarithms, series and probability. The student in the college of arts, and often the one in the college of commerce, is required to obtain his necessary knowledge of arithmetical and algebraic manipulations by taking courses in College Algebra and Analytical Geometry.

This text written for "the use of commercial divisions of colleges and universities" requires no previous mathematical training. Containing material for a year's course, it is divided into three parts:

Part I. Basic Methods of Calculation
Part II. Mathematics of Finance
Part III. Analysis of Statistical Data

Doubtless one would think it unnecessary, under our modern system of secondary education, to review arithmetic and ninth grade algebra; but anyone who has taught the ordinary college freshman knows that, in the years intervening from the ninth grade, most of his mathematical knowledge has departed. Consequently, the author, in a most satisfactory manner, has presented in Part I a review from the very beginning of those operations of arithmetic and algebra that one should know in order to simplify calculations. This part also includes good discussions of graphs, quadratic equations and logarithms. An interesting topic is the construction of a logarithmic table from a table found by successive square root extractions of the number 10.

In Part II one finds chapters on compound interest, annuities, bonds and mortgages—the latter topic especially should be mentioned. This part of the book is simply written, stressing the fundamental principles and the understanding of the ideas rather than the development of formulas to solve everything of which one might think. Sections on the binomial theorem, Newton's method of interpolation and a chapter on series conclude this section of the text.

While Part II discusses its topic completely enough, Part III is only "an introduction to the methods used in analyzing statistics." The material includes both the graphical and analytical transformations which send a parabola, an equilateral hyperbola or an exponential curve into straight lines. The method of least squares is developed to get the equation of the best fitting line or parabola, as well as to write the equations of the regression lines of a correlation table. The usual chapter on probability is followed by one giving the essentials of life insurance. The arithmetic mean, the standard deviation and the coefficient of correlation enter incidentally—no other average, measure of dispersion or measure of relationship is mentioned.

J. R. Musselman

Western Reserve University

The Methods of Statistics, by L. H. C. Tippett. London: Williams and Norgate, Ltd. 1931. 222 pp.

Tippett's excellent book covers a wide range of topics in a most concise manner. The examples and applications given are drawn almost exclusively from the field of biology. The author's own description of the book is terse:

> The first chapters deal with frequency distributions and constants, and with the theory of errors, in orthodox manner, but in the later chapters the underlying theme is Fisher's idea of the Analysis of Variance; correlation is introduced as a special case of this. There are, of course, other ways of regarding the subject, but its unity seems to me to be brought out more by this than by any other method of presentation.

He further says, "I have given mathematical proofs where they are easy; but where they are not, I have not hesitated merely to state the results."

In addition to the Gaussian curve, attention is given to the fitting of binominals and Poisson series, but other non-normal curves are dismissed for, in biology, "It is not often in practical work . . . that any useful purpose is served by fitting such curves . . ." This is something of a disappointment to the reader interested in the social sciences.

The chapter on the theory of random sampling has much merit. He recognizes that the adoption of the .05 level of significance is quite arbitrary and adds that ". . . many investigators prefer a severer criterion (say a probability of .01)." No reason, however, is given for the adoption of either of these. Since it is quite possible that for different types of problems the investigator may wish to adopt different levels of significance, it follows that the invariable use of the .05 level may not be desirable.

Instead of following the Fisher procedure of discussing small samples in conjunction with the various measures, Tippett presents a separate chapter on small samples and observes that the "methods applied to small samples make the interpretation of the data as exact as do the . . . methods applied to large samples." A chapter is devoted to the sampling distribution of the correlation coefficient. Here it is noted, "Contrary to an opinion often expressed, an association measured by the correlation coefficient may be significant in a very small sample if it is strong enough; and this is in accordance with common experience."

Though the pages seem a bit too heavy for the binding, the make-up of the book is otherwise excellent.

Frederick E. Croxton

Columbia University

How to Budget Health, by Evans Clark. New York: Harper and Brothers. 1933. 328 pp.

This book discusses the present situation in medical care, and advocates "medical guilds" as a way out. The guild idea has two essential elements: (1) an all-around medical service including hospitalization and dentistry furnished by a balanced group of salaried physicians, dentists and nurses, and (2) pay-

ment for this service through a fixed annual fee. The guilds are to be private but non-profit organizations, and are most likely to come into existence from the "producer" side, i.e., by a number of physicians pooling their practices and offering their services, as needed, for a flat charge per year. But an association of consumers might also organize a guild by building or purchasing a hospital, and employing the necessary medical personnel.

This proposal, of course, is by no means original with the author. The same arrangement, though under different terminology, was recommended by the Committee on the Costs of Medical Care, and numerous variations of the guild idea, as in some industrial medical services, are already in existence.

A host of studies in the field of medical care has demonstrated the validity of two propositions: (1) a group of salaried physicians, practicing in close co-operation with one another, and utilizing equipment and subsidiary personnel in common, can render better service and at less cost, than the same number of physicians in private, independent practice; and, (2) the costs of medical treatment in cases of severe illness have become so great that if people are to be able to meet them the burden must be distributed through insurance. The facts leading to these conclusions are well presented by the author. But having come thus far, the real problem consists in devising workable arrangements which will embody the two principles of group practice and insurance.

The medical guild here proposed is one possible arrangement. As a solution for the medical problems of the mass of the population, it has the defects of voluntary health insurance. Abroad, the experience has been that voluntary insurance is all right as far as it goes, but that it never goes very far. If the bulk of the working class is to derive the benefits of insurance, there must be legal compulsion to insure. Furthermore, the basic fact in the whole medical situation is that the lower third of the population was too poor, even before the depression, to be able to pay the cost of adequate care. Mr. Clark recognizes this and suggests the necessity of public subsidy. But if the government foots the bill to this extent, it is likely to demand a greater measure of control than is compatible with the plan of privately organized guilds.

A basic difficulty besetting the guild proposal is that in order to get subscribers or patients, the guild may be forced to advertise and to solicit patronage, thus causing its physicians to do as a group what no ethical physician is willing to do as an individual. Furthermore, the establishment of a number of guilds in the same community raises the unpleasing prospects of competition, rate cutting and commercialization. It is these dangers which have caused the organized medical profession to oppose all such forms of practice. The guild plan seems much more practical for a small community with but a single hospital and where all the physicians in the community could be brought into the scheme, than in a large city where many guilds would be necessary.

The whole medical situation is in a state of flux. If one can be sure of anything it is that in years hence people will obtain medical service through other economic arrangements than private practice on a fee-for-service basis, and that no one arrangement will suit the needs of all groups and all communities.

in etiological terms. For the *first* time, this scheme provides for the compilation of *all* diseases which attack a specific organ. Under the system secondary as well as primary diagnoses are recorded, and, in case of death, the *Manual of Joint Causes of Death* (Bureau of the Census) is the accepted guide for classification.

A group of large and small hospitals installed the new system in their record rooms for a trial period of six months in 1932, before final publication. This made possible the correction of errors and omissions before general adoption. More than twenty clinical societies have given the nomenclature their formal approval, and it has been adopted by some of the largest hospitals in the country. The alphabetical index at the end of the volume is very comprehensive, and will greatly facilitate its use as a reference work by clinicians, public health officials and recording offices. Code numbers are supplied, and their derivation and method of use are explained in the Introduction, for the convenience of large hospitals and for organizations such as the federal services, the insurance companies, and health departments, which employ a punch-card system for tabulating morbidity statistics. It is planned to keep the classification constantly abreast of the progress of medicine, which will require frequent revisions in the detailed categories.

Robert E. Chaddock

Columbia University

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A SOCIAL-ECONOMIC GROUPING OF THE GAINFUL WORKERS OF THE UNITED STATES

By Alba M. Edwards, *Bureau of the Census*

In June, 1917, there was presented in this Journal a grouping of the gainful workers of the United States into nine social-economic groups. The real need for such a grouping is shown by the use that has been made of that one. In the present article, this 1917 grouping is revised and 1930 census figures are presented.

As stated in the earlier article, a classification of all occupations according to skill, if it could be made, would be very useful; but a complete classification by skill is impossible, since many occupations do not lend themselves to such a classification. Indeed, none of the professional, proprietary, official, managerial, or clerical pursuits lends itself readily to a classification by skill; and it is doubtful whether any of them may be properly so classified, since in none of them is skill or manual dexterity the chief characteristic. In fact, only those occupations in which the expenditure of muscular force is an important characteristic can be properly classified by skill. While it is plainly impossible to draw a hard and fast line between those occupations characterized principally by the exercise of muscular force or manual dexterity, and those characterized chiefly by the exercise of mental force or ingenuity—or between hand workers and head workers—such a line of demarcation may be made sufficiently exact for our purpose.

The grouping of the gainful workers here presented is not based on skill, except in the case of Groups 4, 5, and 6, most of the occupations in which may be more or less readily classified by skill.

In the construction of these three groups those occupations are considered skilled for the pursuance of which a long period of training or an apprenticeship is usually necessary, and which in their pursuance call for a degree of judgment and of manual dexterity, one or both, above that required in semiskilled occupations. Those occupations are considered semiskilled for the pursuance of which only a short

period or no period of preliminary training is necessary, and which in their pursuance call for only a moderate degree of judgment or of manual dexterity. Unskilled occupations are considered to include those the workers in which require no special training, judgment, or manual dexterity, but supply mainly muscular strength for the performance of coarse, heavy work.

Unfortunately, it has not been possible to classify all manual workers as skilled, semiskilled, or unskilled strictly according to the above concepts. In each group of manual workers, certain of the occupations include some workers who would be better classified by skill in one of the other groups. In fact, each of the groups here presented doubtless contains some workers who do not actually belong there—and some workers who have been included principally for want of a more appropriate place for them. In no group, however, are such workers numerous enough to affect the group total materially.

The occupations of the gainful workers of the United States have been arranged in the following groups:

1. Professional persons
2. Proprietors, managers, and officials
   - 2-a. Farmers (owners and tenants)
   - 2-b. Wholesale and retail dealers
   - 2-c. Other proprietors, managers, and officials
3. Clerks and kindred workers
4. Skilled workers and foremen
5. Semiskilled workers
   - 5-a. Semiskilled workers in manufacturing
   - 5-b. Other semiskilled workers
6. Unskilled workers
   - 6-a. Farm laborers
   - 6-b. Factory and building construction laborers
   - 6-c. Other laborers
   - 6-d. Servant classes

Of the six main groups shown above, three are subdivided, thus making a total of twelve groups. In a given study, the six main groups, the entire twelve groups, or any combination of the main and the sub-groups may be used, and still have comparability with the statistics here presented for the United States.

In Table 1 the specific occupations of the 1930 classification, with the United States totals for each occupation, are so rearranged as to make up the twelve social-economic groups. In Table 2 the twelve groups are presented, by sex, for 1910, 1920, and 1930, the earlier census data having been revised to conform with the 1930 classification.

TABLE 1

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX AND OCCUPATION: 1930

Group and occupation	Male	Female
All gainful workers	38,077,804	10,752,116
1. PROFESSIONAL PERSONS	1,497,934	1,447,863
Actors and showmen	54,611	20,785
Architects	21,621	379
Artists, sculptors, and teachers of art	35,621	21,644
Authors, editors, and reporters	46,922	17,371
Chemists, assayers, and metallurgists	45,163	1,905
Clergymen	145,572	3,276
College presidents and professors	41,774	20,131
Dentists	69,768	1,287
Designers, draftsmen, and inventors	93,519	9,212
Lawyers, judges, and justices	157,220	3,385
Musicians and teachers of music	85,517	79,611
Osteopaths	4,554	1,563
Photographers	31,163	8,366
Physicians and surgeons	146,978	6,825
Teachers	202,337	860,278
Technical engineers	226,136	113
Trained nurses	5,452	288,737
Veterinary surgeons	11,852	11
Other professional pursuits	43,847	70,546
Chiropractors	9,203	2,713
Healers (not elsewhere classified)	7,866	9,774
Religious workers	11,339	19,951
2. PROPRIETORS, MANAGERS, AND OFFICIALS	9,159,896	505,644
2-a <u>Farmers</u> (owners and tenants)	5,749,367	262,645
2-b <u>Wholesale and retail dealers</u>	1,675,193	111,854
Retail dealers	1,593,356	110,166
Wholesale dealers, importers, and exporters	81,837	1,688
2-c <u>Other proprietors, managers, and officials</u>	1,735,336	131,145
Foresters, forest rangers, and timber cruisers	6,042	15
Owners and managers of log and timber camps	6,889	10
Operators, managers, and officials - Extraction of minerals	30,755	141
Builders and building contractors	167,310	202
Manufacturers	202,190	5,711
Managers and officials - Manufacturing	302,334	10,422
Captains, masters, mates, and pilots	24,482	3
Garage owners, managers, and officials	69,543	422
Owners and managers - Truck, transfer, and cab companies	40,508	576
Conductors - Steam railroad	73,332	--
Officials and superintendents - Steam and street railroads	37,983	26
Postmasters	20,816	13,603
Proprietors, managers, and officials* - Transportation	34,987	3,003
Bankers, brokers, and money lenders	212,312	9,192
Managers and officials - Insurance companies	27,556	1,752
Proprietors, managers, and officials* - Trade	42,201	3,104
Managers and officials - Real estate companies	5,124	479
Undertakers	32,192	1,940
Officials and inspectors - City and county	69,431	8,964
Officials and inspectors - State and United States	49,881	1,819
Billiard room, dance hall, etc., keepers	26,819	310
Directors, managers, and officials - Motion picture production	1,886	35
Keepers of charitable and penal institutions	9,468	5,552
Keepers of pleasure resorts, race tracks, etc.	9,741	977
Radio announcers, directors, managers, etc.	1,639	180
Theatrical owners, managers, and officials	18,691	1,032

TABLE I

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX AND OCCUPATION: 1930, *Continued*

Group and occupation	Male	Female
2-c Other proprietors, managers, and officials, Contd		
Owners and proprietors - Cleaning, dyeing, and pressing shops	15,207	1,068
Managers and officials - Cleaning, dyeing, and pressing shops	4,615	1,226
Hotel keepers and managers	39,538	17,310
Laundry owners, managers, and officials	22,483	2,063
Restaurant, cafe, and lunch room keepers	125,308	40,008
3. CLERKS AND KINDRED WORKERS	4,877,235	3,072,220
Inspectors, scalers, and surveyors - Log and timber camps	2,183	1
Baggagemen and freight agents - Railroad	16,361	16
Ticket and station agents - Railroad	25,370	1,790
Agents - Express companies	4,102	74
Express messengers and railway mail clerks	25,600	8
Mail carriers	120,204	1,129
Radio operators	4,909	46
Telegraph messengers	15,997	179
Telegraph operators	51,699	16,122
Telephone operators	13,625	235,259
Advertising agents	43,364	5,656
"Clerks" in stores	238,844	163,147
Commercial travelers	219,790	3,942
Decorators, drapers, and window dressers	13,911	6,238
Inspectors, gaugers, and samplers - Trade	10,923	5,820
Insurance agents	243,974	12,953
Newsboys	38,576	417
Real estate agents	203,119	31,308
Salesmen and saleswomen	1,508,283	560,720
Abstracters, notaries, and justices of peace	9,848	1,908
Architects', designers', and draftsmen's apprentices	2,436	220
Apprentices to other professional persons	3,861	74
Officials of lodges, societies, etc.	11,513	3,002
Technicians and laboratory assistants	8,200	7,700
Dentists' assistants and attendants	770	12,946
Librarians' assistants and attendants	802	1,363
Physicians' and surgeons' attendants	689	13,353
Agents, collectors, and credit men	182,630	13,477
Bookkeepers, cashiers, and accountants	447,937	482,711
Clerks (except "clerks" in stores)	1,290,447	706,553
Messenger, errand, and office boys and girls	81,430	8,949
Stenographers and typists	36,050	775,140
4. SKILLED WORKERS AND FOREMEN	6,201,542	81,145
Farm managers and foremen	66,259	963
Foremen - Log and timber camps	3,910	--
Foremen, overseers, and inspectors - Extraction of minerals	34,274	12
Blacksmiths, forgemen, and hammermen	147,400	9
Boilermakers	49,923	--
Brick and stone masons and tile layers	170,096	7
Cabinetmakers	57,090	7
Carpenters	929,370	50
Compositors, linotypers, and typesetters	173,363	10,269
Coopers	11,347	--
Electricians	280,279	38
Electrotypers, stereotypers, and lithographers	16,440	244
Engineers (stationary), cranemen, hoistmen, etc.	316,942	22
Engravers	10,747	690
Foremen and overseers - Manufacturing	310,037	28,467
Puddlers	1,597	--
Glass blowers	3,200	59
Jewelers, watchmakers, goldsmiths, and silversmiths	37,408	1,254
Loom fixers	19,160	35
Machinists, millwrights, and toolmakers	761,075	20
Mechanics*	630,190	63
Millers (grain, flour, feed, etc.)	15,906	40

TABLE 1

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX AND OCCUPATION: 1930, *Continued*

Group and occupation	Male	Female
4. SKILLED WORKERS AND FOREMEN, Continued		
Molders, founders, and casters (metal)	106,139	19
Painters, glaziers, and varnishers (building)	429,962	123
Paper hangers	26,872	1,456
Pattern and model makers	29,711	39
Piano and organ tuners	6,799	24
Plasterers and cement finishers	85,477	3
Plumbers and gas and steam fitters	237,813	1
Pressmen and plate printers (printing)	31,218	--
Rollers and roll hands (metal)	30,765	--
Roofers and slaters	23,636	--
Sawyers	35,984	80
Shoemakers and cobblers (not in factory)	76,127	261
Skilled occupations (not elsewhere classified)	12,227	31
Stonecutters	22,887	1
Structural iron workers (building)	28,966	--
Tailors and tailoresses	147,476	21,807
Tinsmiths and coppersmiths	83,421	6
Upholsterers	49,097	2,355
Bus conductors	1,002	--
Conductors - Street railroad	35,660	17
Foremen and overseers - Steam and street railroads	79,682	55
Locomotive engineers	101,201	--
Locomotive firemen	67,096	--
Aviators	6,031	66
Foremen and overseers* - Transportation	52,061	74
Inspectors - Transportation	50,965	1,155
Floorwalkers, foremen, and overseers - Trade	33,368	4,795
Firemen - Fire department	73,008	--
Marshals, sheriffs, detectives, etc.	39,247	2,576
Policemen	130,838	840
Foremen and overseers - Cleaning, dyeing, and pressing shops	470	349
Foremen and overseers - Laundries	3,583	2,764
5. SEMISKILLED WORKERS	5,448,158	2,529,414
5-a Semiskilled workers in manufacturing	2,881,022	1,676,971
Apprentices to building and hand trades	40,105	28
Apprentices (except to building and hand trades) - Manufacturing	33,450	3,869
Bakers	131,884	8,916
Dressmakers and seamstresses (not in factory)	452	157,928
Dyers	17,425	294
Filers, grinders, buffers, and polishers (metal)	76,264	2,336
Milliners and millinery dealers	4,846	40,102
Oilers of machinery	31,169	41
Enamelers, lacquerers, and japanners	4,622	1,136
Painters, glaziers, and varnishers (factory)	89,546	3,522
Operatives* - Manufacturing	2,451,259	1,458,799
5-b Other semiskilled workers	2,567,136	852,443
Boatmen, canal men, and lock keepers	5,603	40
Sailors and deck hands	64,692	8
Chauffeurs and truck and tractor drivers	970,916	1,502
Boiler washers and engine hostlers	18,300	--
Brakemen - Steam railroad	88,197	--
Motormen - Steam and street railroads	60,718	5
Switchmen, flagmen, and yardmen - Steam and street railroads	102,484	289
Telegraph and telephone linemen	71,624	1
Apprentices - Transportation	6,097	54
Other occupations - Transportation	83,704	1,923
Apprentices - Wholesale and retail trade	2,337	107
Deliverymen- Bakeries and stores	159,328	116
Other pursuits in trade	96,060	29,106

TABLE 1

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX AND OCCUPATION: 1930, *Continued*

Group and occupation	Male	Female
5-b Other semiskilled workers, Continued		
Guards, watchmen, and doorkeepers	147,115	1,000
Soldiers, sailors, and marines	132,630	--
Other public service pursuits	40,309	1,268
Other occupations - Professional service	8,765	1,768
Attendants - Pool rooms, bowling alleys, golf clubs, etc.	16,047	121
Helpers - Motion picture production	1,234	979
Theater ushers	9,308	3,153
Other attendants and helpers - Professional service	28,690	21,480
Barbers, hairdressers, and manicurists	261,096	113,194
Boarding and lodging house keepers	17,093	127,278
Other operatives - Cleaning, dyeing, and pressing shops	42,313	18,321
Housekeepers and stewards	20,303	230,383
Deliverymen - Laundries	20,550	15
Other operatives - Laundries	45,067	140,414
Midwives and nurses (not trained)	13,807	143,142
Other pursuits - Domestic and personal service	32,022	1,808
6. UNSKILLED WORKERS	10,893,039	3,115,830
6-a Farm laborers	3,746,433	646,331
6-b Factory and building construction laborers	3,248,022	125,521
Firemen (except locomotive and fire department)	127,293	1
Furnace men, smelter men, and pourers	18,027	--
Heaters (metal)	14,941	1
Laborers* - Manufacturing	3,087,761	125,519
6-c Other laborers	2,871,744	31,321
Fishermen and oystermen	73,071	209
Teamsters and haulers - Log and timber camps	9,242	1
Other lumbermen, raftsmen, and woodchoppers	146,803	93
Coal mine operatives	621,645	116
Other operatives in extraction of minerals	296,990	490
Longshoremen and stevedores	73,944	10
Draymen, teamsters, and carriage drivers	111,178	46
Garage laborers	80,536	157
Hostlers and stable hands	8,654	--
Laborers - Truck, transfer, and cab companies	40,920	50
Laborers - Road and street	306,980	47
Laborers, including construction laborers - Steam and street railroads	459,090	3,384
Laborers* - Transportation	50,998	65
Laborers in coal and lumber yards, warehouses, etc.	113,027	642
Laborers, porters, and helpers in stores	199,208	9,392
Laborers - Public service	165,903	1,107
Laborers - Professional service	23,762	1,621
Laborers - Recreation and amusement	29,458	436
Stage hands and circus helpers	4,009	175
Laborers - Cleaning, dyeing, and pressing shops	3,010	639
Laborers - Domestic and personal service	67,337	4,300
Laborers - Laundries	11,001	8,292
6-d Servant classes	1,026,240	2,312,657
Bootblacks	18,747	37
Charwomen and cleaners	20,943	40,959
Elevator tenders	66,236	12,369
Janitors and sextons	273,508	35,820
Launderers and laundresses (not in laundry)	4,565	356,468
Porters (except in stores)	127,436	52
Servants	364,174	1,634,959
Waiters	161,315	231,973

* Not otherwise specified

TABLE 2

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX: 1910 TO 1930

Census year and group	Total		Male		Female	
	Number	Per cent	Number	Per cent	Number	Per cent
1930	48,829,920	100.0	38,077,804	100.0	10,752,116	100.0
1. PROFESSIONAL PERSONS	2,945,797	6.0	1,497,934	3.9	1,447,863	13.5
2. PROPRIETORS, MANAGERS, AND OFFICIALS	9,665,640	19.8	9,159,996	24.1	505,644	4.7
2-a Farmers (owners and tenants)	6,012,012	12.3	5,749,367	15.1	262,645	2.4
2-b Wholesale and retail dealers	1,787,047	3.7	1,675,193	4.4	111,854	1.0
2-c Other proprietors, managers, and officials	1,866,481	3.8	1,735,336	4.6	131,145	1.2
3. CLERKS AND KINDRED WORKERS	7,949,455	16.3	4,877,235	12.8	3,072,220	28.6
4. SKILLED WORKERS AND FOREMEN	6,282,687	12.9	6,201,542	16.3	81,145	0.8
5. SEMISKILLED WORKERS	7,977,572	16.3	5,448,158	14.3	2,529,414	23.5
5-a Semiskilled workers in manufacturing	4,557,993	9.3	2,881,022	7.6	1,676,971	15.6
5-b Other semiskilled workers	3,419,579	7.0	2,567,136	6.7	852,443	7.9
6. UNSKILLED WORKERS	14,008,869	28.7	10,893,039	28.6	3,115,830	29.0
6-a Farm laborers	4,392,764	9.0	3,746,433	9.8	646,331	6.0
6-b Factory and building construction laborers	3,374,143	6.9	3,248,622	8.5	125,521	1.2
6-c Other laborers	2,903,065	5.9	2,871,744	7.5	31,321	0.3
6-d Servant classes	3,338,897	6.8	1,026,240	2.7	2,312,657	21.5
1920	41,614,248	100.0	33,064,737	100.0	8,549,511	100.0
1. PROFESSIONAL PERSONS	2,050,162	4.9	1,061,791	3.2	988,371	11.6
2. PROPRIETORS, MANAGERS, AND OFFICIALS	9,180,583	22.1	8,757,614	26.5	422,969	4.9
2-a Farmers (owners and tenants)	6,387,360	15.3	6,121,783	18.5	265,577	3.1
2-b Wholesale and retail dealers	1,401,849	3.4	1,322,075	4.0	79,774	0.9
2-c Other proprs, mgrs, and off.	1,391,374	3.3	1,313,756	4.0	77,618	0.9
3. CLERKS AND KINDRED WORKERS	5,704,970	13.7	3,511,808	10.6	2,193,162	25.7
4. SKILLED WORKERS AND FOREMEN	5,570,602	13.4	5,469,048	16.5	101,554	1.2
5. SEMISKILLED WORKERS	6,638,615	16.0	4,375,995	13.2	2,262,620	26.5
5-a Semiskilled workers in mfg.	4,357,451	10.5	2,689,245	8.1	1,668,206	19.5
5-b Other semiskilled workers	2,281,164	5.5	1,686,750	5.1	594,414	7.0
6. UNSKILLED WORKERS	12,469,316	30.0	9,888,481	29.9	2,580,835	30.2
6-a Farm laborers	4,186,128	10.1	3,382,899	10.2	803,229	9.4
6-b Factory & bldg cstn laborers	3,136,276	7.5	2,966,841	9.0	169,435	2.0
6-c Other laborers	2,890,738	6.9	2,859,343	8.6	31,395	0.4
6-d Servant classes	2,256,174	5.4	679,398	2.1	1,576,776	18.4
1910	38,167,336	100.0	30,091,564	100.0	8,075,772	100.0
1. PROFESSIONAL PERSONS	1,632,638	4.3	913,866	3.3	718,772	8.9
2. PROPRIETORS, MANAGERS, AND OFFICIALS	8,479,746	22.2	8,083,563	26.9	396,183	4.9
2-a Farmers (owners and tenants)	6,132,380	16.1	5,859,238	19.5	273,142	3.4
2-b Wholesale and retail dealers	1,246,077	3.3	1,178,049	3.9	68,028	0.8
2-c Other proprs, mgrs, and off.	1,101,289	2.9	1,046,276	3.5	55,013	0.7
3. CLERKS AND KINDRED WORKERS	3,826,959	10.0	2,744,488	9.1	1,082,471	13.4
4. SKILLED WORKERS AND FOREMEN	4,464,060	11.7	4,367,327	14.5	96,733	1.2
5. SEMISKILLED WORKERS	5,512,344	14.4	3,326,830	11.1	2,185,514	27.1
5-a Semiskilled workers in mfg.	3,674,302	9.6	2,032,346	6.8	1,641,956	20.3
5-b Other semiskilled workers	1,838,042	4.8	1,294,484	4.3	543,558	6.7
6. UNSKILLED WORKERS	14,251,589	37.3	10,655,490	35.4	3,596,099	44.5
6-a Farm laborers	6,205,633	16.3	4,679,926	15.6	1,525,707	18.9
6-b Factory & bldg cstn laborers	2,659,917	7.0	2,571,215	8.5	88,702	1.1
6-c Other laborers	2,821,526	7.4	2,803,596	9.3	17,930	0.2
6-d Servant classes	2,564,513	6.7	600,753	2.0	1,963,760	24.3

According to Table 2, in 1930 almost 1 gainful worker in 16 was a professional person, and almost 1 in 5 was a proprietor, manager, or official. Clerks and kindred workers, frequently referred to as "white-collar workers," accounted for nearly 1 worker in 6. More than 1 worker in 8 was skilled, nearly 1 in 6 was semiskilled, and considerably over 1 in 4 was unskilled. These last three groups combined constitute the manual workers. To distinguish them from the "white-collar workers," they may appropriately be called the "overalls and apron workers." Together, they numbered, in 1930, considerably over one-half (57.9 per cent) of all gainful workers.

During the 20-year period from 1910 to 1930, there were some significant changes in the distribution of the gainful workers among the twelve social-economic groups shown in Table 2. Farmers decreased strikingly from 16.1 to 12.3 per cent of the total, and farm laborers from 16.3 to 9 per cent. There was a slight decrease in the proportion classed as semiskilled workers in manufacturing, in the proportion classed as factory and building construction laborers, and in the proportion classed as "Other laborers." While the proportion of the total in each of the other seven groups increased during the 20-year period, the increase was marked only in the case of the clerical group—from 10 per cent in 1910 to 16.3 per cent in 1930.

At each census the distribution of female gainful workers by social-economic groups has differed considerably from that of male workers. As compared with the corresponding proportion for males, the proportion of the females in the professional group, in the clerical group, in the semiskilled group, and in the servant group, is particularly large; and the proportion in the proprietary, official, and managerial group, in the skilled-worker group, and in the different laborer groups is particularly small. There was a very striking increase between 1910 and 1930 in the proportion of female workers engaged in clerical and kindred pursuits, a marked decrease in the proportion employed as semiskilled factory workers and as agricultural laborers, and a considerable decrease in the proportion employed as servants.

The most significant changes between 1910 and 1930 in the distribution of the male workers were the decrease in the proportion farmers formed of the total, from 19.5 per cent to 15.1 per cent, and the decrease in the proportion farm laborers formed of the total, from 15.6 per cent to 9.8 per cent.

Table 3 shows for native whites, foreign-born whites, and Negroes, the gainful workers in 1930 classified into social-economic groups, by sex.

TABLE 3

GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY COLOR, NATIVITY, AND SEX: 1930

Population class and group	Total		Male		Female	
	Number	Per cent	Number	Per cent	Number	Per cent
NATIVE WHITE	35,173,370	100.0	27,511,862	100.0	7,661,508	100.0
1. PROFESSIONAL PERSONS	2,532,206	7.2	1,243,081	4.5	1,289,125	16.8
2. PROPRIETORS, MANAGERS, AND OFFICIALS	7,370,028	21.0	7,017,203	25.5	352,825	4.6
2-a Farmers (owners and tenants)	4,599,201	13.1	4,436,416	16.1	162,785	2.1
2-b Wholesale and retail dealers	1,248,518	3.5	1,169,058	4.2	79,460	1.0
2-c Other proprietors, managers, and officials	1,523,309	4.3	1,412,727	5.1	110,582	1.4
3. CLERKS AND KINDRED WORKERS	7,103,717	20.2	4,262,882	15.5	2,840,835	37.1
4. SKILLED WORKERS AND FOREMEN	4,688,661	13.3	4,623,705	16.8	64,956	0.8
5. SEMISKILLED WORKERS	5,787,380	16.5	3,886,352	14.1	1,901,028	24.8
5-a Semiskilled workers in manufacturing	3,256,427	9.3	1,958,928	7.1	1,297,499	16.9
5-b Other semiskilled workers	2,530,953	7.2	1,927,424	7.0	603,529	7.9
6. UNSKILLED WORKERS	7,691,378	21.9	6,478,639	23.5	1,212,739	15.8
6-a Farm laborers	2,863,482	8.1	2,659,897	9.7	203,585	2.7
6-b Factory and building construction laborers	1,861,660	5.3	1,774,693	6.5	86,967	1.1
6-c Other laborers	1,690,938	4.8	1,672,688	6.1	18,250	0.2
6-d Servant classes	1,275,298	3.6	371,361	1.3	903,937	11.8
FOREIGN-BORN WHITE	7,411,127	100.0	6,255,071	100.0	1,156,056	100.0
1. PROFESSIONAL PERSONS	287,243	3.9	191,781	3.1	95,462	8.3
2. PROPRIETORS, MANAGERS, AND OFFICIALS	1,263,289	17.0	1,201,688	19.2	61,601	5.3
2-a Farmers (owners and tenants)	468,322	6.3	447,205	7.1	21,117	1.8
2-b Wholesale and retail dealers	493,431	6.7	466,059	7.5	27,372	2.4
2-c Other proprs, mgrs, and off.	301,536	4.1	288,424	4.6	13,112	1.1
3. CLERKS AND KINDRED WORKERS	731,204	9.9	528,593	8.5	202,611	17.5
4. SKILLED WORKERS AND FOREMEN	1,381,971	18.6	1,367,463	21.9	14,508	1.3
5. SEMISKILLED WORKERS	1,594,471	21.5	1,180,294	18.9	414,177	35.8
5-a Semiskilled workers in mfg.	1,082,214	14.6	797,648	12.8	284,566	24.6
5-b Other semiskilled workers	512,257	6.9	382,646	6.1	129,611	11.2
6. UNSKILLED WORKERS	2,152,949	29.1	1,785,252	28.5	367,697	31.8
6-a Farm laborers	199,579	2.7	194,358	3.1	5,221	0.5
6-b Factory & bldg cstn laborers	750,640	10.1	737,108	11.8	13,532	1.2
6-c Other laborers	591,005	8.0	586,448	9.4	4,557	0.4
6-d Servant classes	611,725	8.3	267,338	4.3	344,387	29.8
NEGRO	5,503,535	100.0	3,662,893	100.0	1,840,642	100.0
1. PROFESSIONAL PERSONS	115,765	2.1	55,610	1.5	60,155	3.3
2. PROPRIETORS, MANAGERS, AND OFFICIALS	929,644	16.9	842,920	23.0	86,724	4.7
2-a Farmers (owners and tenants)	873,653	15.9	797,231	21.8	76,422	4.2
2-b Wholesale and retail dealers	28,343	0.5	24,493	0.7	3,850	0.2
2-c Other proprs, mgrs, and off.	27,648	0.5	21,196	0.6	6,452	0.4
3. CLERKS AND KINDRED WORKERS	82,669	1.5	62,138	1.7	20,531	1.1
4. SKILLED WORKERS AND FOREMEN	176,912	3.2	175,537	4.8	1,375	0.1
5. SEMISKILLED WORKERS	515,381	9.4	329,374	9.0	186,007	10.1
5-a Semiskilled workers in mfg.	181,079	3.3	104,441	2.9	76,638	4.2
5-b Other semiskilled workers	334,302	6.1	224,933	6.1	109,369	5.9
6. UNSKILLED WORKERS	3,683,164	66.9	2,197,314	60.0	1,485,850	80.7
6-a Farm laborers	1,112,510	20.2	693,669	18.9	418,841	22.8
6-b Factory & bldg cstn laborers	674,187	12.3	650,925	17.8	23,262	1.3
6-c Other laborers	516,414	9.4	508,754	13.9	7,660	0.4
6-d Servant classes	1,380,053	25.1	343,986	9.4	1,036,067	56.3

The six main occupation groups shown in Table 3 are arranged, approximately at least, in descending order of the social-economic status of the workers in them. Hence the percentage distribution of the workers among these six main groups, as presented in Column 2, furnishes a convenient basis for comparing the social-economic status of the workers in the different population classes in 1930. A larger percentage of the native whites than of the foreign-born whites was in each of the first three main groups and a much smaller percentage was in each of the last three. The percentage, both of native whites and of foreign-born whites, was larger than that of Negroes in each main group except "Unskilled workers," where the percentage was over three times as large for Negroes as for native whites and considerably over twice as high for Negroes as for foreign-born whites. More than 2 out of 3 Negro workers in 1930 were unskilled; and the proportions of the Negro workers in the semiskilled group, in the skilled group, and in the clerical group were very small as compared with the corresponding proportions for native whites and foreign-born whites.

In 1930, 48.3 per cent of the native white workers, 30.8 per cent of the foreign-born white workers, and 20.5 per cent of the Negro workers were in the first three main groups—the groups comprising the "head workers." In contrast, 51.7 per cent of the native white workers, 69.2 per cent of the foreign-born white workers, and 70.5 per cent of the Negro workers were in the last three main groups—the groups comprising the "hand workers."

Possibly the relative proportions of the workers of the different population classes in the first three main groups of Table 3 may be accepted as a rough measure of the relative social-economic status of the different population classes in 1930. If so, the social-economic status of foreign-born whites was 63.6 per cent as high as that of native whites, and the social-economic status of Negroes was 42.4 per cent as high as that of native whites.

If, in Table 3, group 1 be combined with 2, 3 with 4, and 5 with 6, then it develops that, in 1930, 28.2 per cent of the native white workers, 20.9 per cent of the foreign-born white workers, and 19 per cent of the Negro workers were professional persons, proprietors, managers, or officials. Clerks and kindred workers, skilled workers, and foremen together formed 33.5 per cent of the native white workers, 28.5 per cent of the foreign-born white workers, and 4.7 per cent of the Negro workers. Semiskilled and unskilled workers combined constituted 38.3 per cent of the native white workers, 50.6 per cent of the foreign-born white workers, and 76.3 per cent of the Negro workers.

The relatively large proportion of the Negro workers classed as "Proprietors, managers, and officials" is explained by the fact that 15.9 per cent of the Negroes, as compared with 13.1 per cent of the native whites and 6.3 per cent of the foreign-born whites, were farmers (owners or tenants).

The distribution of the male gainful workers of the different population classes by social-economic status is very similar to the corresponding distribution of the total gainful workers, above discussed.

The proportion of the total female workers engaged in professional pursuits in 1930 was over twice as high for native whites as for foreign-born whites, and over five times as high for native whites as for Negroes. Likewise, the proportion engaged in clerical and kindred pursuits was over twice as high for native whites as for foreign-born whites and nearly thirty-four times as high for native whites as for Negroes. The proportion engaged in semiskilled occupations was highest for foreign-born whites, next highest for native whites, and lowest for Negroes. The proportion engaged in unskilled occupations was over twice as high for foreign-born whites as for native whites, and was over five times as high for Negroes as for native whites.

Professional persons, proprietors, managers, and officials together formed 21.4 per cent of the native white female workers, 13.6 per cent of the foreign-born white female workers, and 8 per cent of the Negro female workers, in 1930. Clerks and kindred workers, skilled workers, and foremen combined constituted 37.9 per cent of the native white female workers, 18.8 per cent of the foreign-born white female workers, and 1.2 per cent of the Negro female workers. Semiskilled and unskilled workers together accounted for 40.6 per cent of the native white female workers, 67.6 per cent of the foreign-born white female workers, and 90.8 per cent of the Negro female workers. The different servant occupations gave employment to 56.3 per cent of the Negro female workers, in 1930, and 22.8 per cent of them were agricultural laborers.

The foregoing discussion and the statistics presented therewith relate to the United States as a whole. The gainful workers of any state or any city of 100,000 or more can be grouped in accordance with the social-economic classification, however, on the basis of the census data on occupations.[1] Both state and city figures are given in Table 4 of the State Bulletin on Occupations—or of the state section in Volume IV of the Fifteenth Census Reports on Population.

[1] Census occupation statistics are presented for 1930, 1920, and 1910, in Table 1, Ch. 1, of Vol. V of the Fifteenth Census Reports on Population. The 1930 statistics are presented by color and nativity in Table 13 of the United States Summary on Occupations; in Table 13 of the United States section of Vol. IV; and in Table 3, Ch. 3, of Vol. V of the Fifteenth Census Reports on Population.

A STATISTICAL METHOD FOR ESTIMATING THE DISTRIBUTION OF SIZES OF COMPLETED FRATERNITIES IN A POPULATION REPRESENTED BY A RANDOM SAMPLING OF INDIVIDUALS[1]

By Barbara S. Burks, *Institute of Child Welfare, University of California*

In studies of birth trends and differential fertility it is often desirable but difficult to secure data upon the distribution of sizes or upon the average size of completed families. A method is herewith presented for estimating this distribution and average size for the total population from which a sample of individuals belonging to fraternities of varying completeness is drawn. Formulae are presented for the standard errors of estimate; several illustrations of application to data are given; and a check of the method against fact is provided through material involving 1,800 fraternities complete or approximately so.

We take a random group of individuals from the population to be studied and ascertain their birth orders.[2] It is desirable that these individuals should be within a few years of one another in age so that changing birth rates, differential age mortality, and other factors will not introduce complications. Our problem is to find the distribution of sizes of ultimately completed fraternities which would yield the composition of birth orders found in our sample. Let the number of fraternities which will be completed with one child, two children, n children, etc., be proportional to $\varphi(1)$, $\varphi(2)$, $\varphi(n)$. Let $N(\nu)$ equal the number of children in our sample of given birth order, ν.

Since fraternities of given completed size tend to produce during any period equal numbers of children of each birth order they contain, then, even though these fraternities in the sample vary in completeness, the several birth orders will stand equal chances of being "caught." This means that

$$N(n)=\varphi(n)+\varphi(n+1)+\varphi(n+2)\ \ldots \tag{1}$$

or, in detail, our sample will contain,

[1] Acknowledgment is made to Dr. J. R. Oppenheimer, Dr. Harold E. Jones, Dr. Herbert S. Conrad, and Dr. Sidney Adams, who read and criticized the manuscript. The author is greatly indebted to Dr. Oppenheimer for his derivations of two formulae for standard errors, (6) and (7).

[2] The selection of *individuals* must be random within the group defined; it would not be permissible to take all of the offspring of a random set of families. It is preferable to find the actual birth orders with respect to all siblings, living and dead, but if this is not possible, corrections for mortality can later be made.

$$
\begin{array}{lll}
 & \text{1st born children,} & \varphi(1)+\varphi(2)+\varphi(3)\ \ldots\ +\varphi(l-1)+\varphi(l)=N(1) \\
 & \text{2nd born children,} & \varphi(2)+\varphi(3)\ \ldots\ +\varphi(l-1)+\varphi(l)=N(2) \\
\text{(1a)} & \text{3rd born children,} & \varphi(3)\ \ldots\ +\varphi(l-1)+\varphi(l)=N(3) \\
\ldots & \ldots & \ldots \\
 & (l-1)^{th}\text{ born children,} & \varphi(l-1)+\varphi(l)=N(l-1) \\
 & l^{th}\text{ born children,} & \varphi(l)=N(l)
\end{array}
$$

We have supposed for simplicity in work that φ is zero for $n>l$, i.e., that in our sample no families appear with more than l children.

Solving, we get

$$\varphi(n)=\delta N(n) \quad \text{where} \tag{2}$$

$$\delta N(n)=N(n)-N(n+1) \tag{3}$$

This is the solution of our problem. The proportional number of fraternities of given n is the difference in the number of children of birth order n and the number of birth order $n+1$. To obtain the percentage distribution it is of course necessary only to divide each $\varphi(n)$ by $\sum_1^l\varphi(n)$, which is simplified by the fact, from (1a), that

$$\sum_1^l\varphi(n)=N(1) \tag{4}$$

It is not out of place to mention here a point which has caused intermittent concern in population studies. It has sometimes happened in tabulations of the distribution of fraternal sizes that no allowance has been made for the fact that an n-sized fraternity is n times as likely to be represented in any "drag-net" sample as a one-child fraternity. Disregard of this fact has caused the computed average size and the incidence of large fraternities to appear grotesquely high. With the present method, the necessary weighting for the size-selective incidence of fraternities is inherent, for fraternities of given size occur only once in our $\varphi(n)$ distribution, regardless of size. This is obvious from (1), (2) and (3).

The estimated average size, m, of completed fraternities is more frequently of interest than is the distribution of sizes, and is always to be determined with greater ease and with less error of estimate. When the average alone is desired it is not necessary to make a frequency distribution, $N(\nu)$, but only to ascertain the number of first born children in our sample. We may write, from (1a),

$$m=\frac{\sum_1^l n\varphi(n)}{\sum_1^l\varphi(n)}=\frac{N}{N(1)} \tag{5}$$

which means that the average size of the fraternities is given by the number of children divided by the number of families.

The standard error of estimate, σ, of the function m, and the standard error of estimate, S_n, of the function, $\varphi(n)$, have been derived by J. R. Oppenheimer. These are given by the following formulae:

$$(6) \quad \sigma/m = \sqrt{m-1/N}$$

$$(7) \quad S_n/\varphi(n) =$$

$$N^{-\frac{1}{2}} \frac{\{p(n)\,[1-p(n)]+p(n+1)\,[1-p(n+1)]+2p(n)\;p(n+1)\}^{\frac{1}{2}}}{p(n)-p(n+1)}$$

APPLICATIONS TO CURRENT POPULATION STUDIES

(A) *Completed fraternities in United States Birth Registration Area.* The annual census report upon births[1] has included since 1917 a tabulation of birth orders. While there is lack of uniformity in reports from the several states, some including previous stillbirths in calculating birth orders and some including only previous live births, this matters little in fact, since stillbirths constitute only about 4 per cent of total births. Statistics for the year 1928 were chosen since such data would be useful to compare with some on hand for Berkeley. (Illustration B.) The data exclude 10,000 births for which birth order was unknown, and returns from five states not furnishing birth order statistics.

From Table I we may draw the interesting deduction that the one-child family now has an incidence higher than that of any other size. One-child and two-child families together account for 52 per cent of the total number. The estimated average size is 3.28 (standard error, .003) a number only slightly above that needed to maintain a stationary population in the face of child mortality and the infecundity of large groups not represented in a tabulation of fertile families.

Birth order data on 1,187,000 births ten years earlier yield an estimated average size of completed fraternities equal to 3.63 (standard error, .005). War time conditions of 1918 may have introduced certain errors into this estimate. However, the figure 3.63 differs very little from the average number of children per mother, 3.68, calculated by a different method by Dublin and Lotka from the conditions of maternity and mortality prevailing among white females in 1920.[2] Both averages

[1] *Birth, Stillbirth, and Infant Mortality Statistics.*

[2] L. I. Dublin and A. J. Lotka, "On the True Rate of Natural Increase," this JOURNAL, 1925, pp. 305–330. The calculation of these authors was incidental to a study of secular rate of increase, and depended upon the use of (a) census data on age composition of the total female population, of married women, and of women bearing children in 1920, and (b) life expectation tables giving the probability at birth of reaching the various ages of child bearing.

are doubtless a little lower than would have been the case if they had included certain fecund southern states which later were incorporated into the Birth Registration Area.

The Immigration Commission in its 1911 *Annual Report* furnished data upon the fecundity of Rhode Island, Ohio, and Minnesota urban and rural women who had been married ten to nineteen years at the time of the 1900 United States Census. The average number of offspring for all groups was 4.1; for native white of white parentage, 2.7; for foreign-born white, 4.7. These data, combined with our estimates of average fraternal size based on the 1918 and 1928 birth statistics, provide striking evidence of declining family size in this country.

(B) *Average size of completed fraternities in Berkeley, California.* A survey was made between January, 1928, and June, 1929, of families represented by every third child born in Berkeley during the period.[1] The total number of live births was 402, the number of first born children, 171, the estimated average size of completed fraternities, 2.4, with a standard error of estimate of .11. The average is seen to be only 73 per cent of that for the country at large in 1928.

(C) *Average size of completed fraternities of gifted school pupils in California.* The gifted subjects were studied by Lewis M. Terman in 1922.[2] On the basis of data from 91 families already complete (mothers over 45) at the time of the investigation, the average fraternal size was found to be 2.2. None of the gifted children, however, was over 13, and thus the 91 mothers were all over 32 when these children were born. As first children are usually born before their mothers are 32, the selection discriminated against one-child families.

Pregnancy orders (though not orders of live births) were available for 574 of the gifted subjects. Of these, 273 resulted from first pregnancies, 153 from second, 80 from third, 36 from fourth, and the remainder from higher orders. The percentage of miscarriage in the pregnancies of this group of mothers (exclusive of the pregnancies of the propositus children) was 17.4. Making the assumption (approximately true) that the miscarriage rate was constant for the orders of pregnancy involved, we estimate that .174 of the second pregnancy subjects were actually first born $(.174)^2$ of the third pregnancy subjects, and $(.174)^3$ of the fourth pregnancy subjects. We must therefore add 30.2 to the 273 cases of first pregnancies to get the probable number of first born.

[1] Part of a large-scale investigation conducted by the Institute of Child Welfare, University of California.

[2] L. M. Terman et al., *Mental and Physical Traits of a Thousand Gifted Children*, Stanford, 1926 (2nd ed.), pp. 113 ff.

TABLE I

DISTRIBUTION OF ESTIMATED COMPLETED FRATERNITIES IN THE UNITED STATES BIRTH REGISTRATION AREA*

ν, Birth order n, Completed size	$N(\nu)$ Children born in 1928	$d(n)$ Completed fraternities	$d(n)/N(1)$ Percentage of completed fraternities
1	635,820	184,437	28.8
2	452,384	148,874	23.4
3	304,610	96,058	15.1
4	207,452	62,059	9.8
5	141,704	40,346	6.3
6	101,447	28,229	4.4
7	70,248	20,551	3.2
8	55,667	16,961	2.7
9	38,796	11,562	1.8
10	27,144	10,197	1.6
11	16,947	6,342	1.0
12	10,635	4,593	0.7
13	6,042	2,625	0.4
14	3,417	1,662	0.3
15	1,755	848	0.1
16	967	438	
17	469	198	
18	271	132	
19	139	61	
20	78	52	
21	26	8	0.1
22	18	6	
23	18	7	
24	11	5	
25	6	3	
26	3	3	
Sum	2,080,882	635,820	99.8

Estimated average size, $m=2{,}080{,}882/635{,}820=3.28$
Standard error of estimate, $\sigma=0.004$

* Based upon birth orders reported for 1928 in *Birth, Stillbirth and Infant Mortality Statistics*. Excluded were births from five states not reporting upon birth orders, and 10,000 additional cases for which birth order was unknown.

$$m=\frac{574}{303.2}=1.9$$

$$\sigma= \qquad .08$$

(D) *Estimated and actual completed sizes of fraternities of college students.* Data on family order and fraternal size of 1,800 University of California students enrolled in elementary psychology classes between the years of 1924 and 1929 were made available through the courtesy of Professor George M. Stratton. The material and estimates here refer only to surviving offspring. The students were all in the second year of college or above; nearly all, therefore, were over 18 years of age, and it may be assumed that practically all their fraternities were complete. In Table II are tabulated the essential data and results for this group.

When checking the estimated sizes against the actual sizes of completed fraternities we must recall the fact (mentioned p. 389) that an n-sized fraternity is n times as likely to be represented in any "drag-

net" sample of offspring as a one-child fraternity; that small families are thereby selected against. This fact is allowed for in the method of estimate developed in the present paper; hence column 3 of Table II gives the estimated percentage distribution of fraternal size in the stratum of fertile families *represented* by the students, though not in the families of the students themselves. To find the proportional distribution of sizes of actually complete fraternities in the stratum of population from which the students are drawn, it is first necessary to weight the fraternal size-class frequencies of column 4. The frequency $\varphi'(2)$ of two-child fraternities must be divided by two, the frequency $\varphi'(3)$ of three-child fraternities by three, . . . the frequency $\varphi'(n)$ of n-child fraternities by n. From the resulting weighted frequencies, the percentage incidence in each size-class of completed fraternities is then calculated (column 5 of Table II).

From the figures in Table II it is seen that the agreement between estimated average size and actual average size in the stratum represented by the students is exact to the first decimal place. The distributions of sizes, too, show agreement as close as the errors of estimate would lead us to expect. The estimated proportion of completed one-child families, 42.9, which shows the largest absolute (though not relative) discrepancy from the actual proportion, has a standard error of 4.3 by formula (7).

As a check upon the derived formulae for standard errors of estimate, the data for the 1,800 students were shuffled into 18 random groups of 100 each. The relative standard deviations were computed for the distributions of m, $\varphi(1)$, $\varphi(3)$, and $\varphi(7)$ in the 18 samples, and compared with those required by the formulae. The following result gives as good agreement as we could expect from the limited number of samples:

	Computed from 18 samples of $N=100$	Calculated by formula for $N=100$
σ/m	.10	.11
$S_1/\varphi(1)$	.43	.39
$S_3/\varphi(3)$	.59	.49
$S_7/\varphi(7)$	1.37	1.45

SOURCES OF ERROR

The estimates of fraternal size distribution would be completely valid only in a population that was stationary with respect to fraternal size and age composition of married individuals. It is because these factors are often in flux that it is important when making estimates to choose a population sample within a narrow age range. But even if the individuals of our sample are of exactly the same age, their frater-

TABLE II

COMPARISON OF ESTIMATED AND ACTUAL DISTRIBUTIONS OF COMPLETED FRATERNITIES IN A GROUP OF 1,800 COLLEGE STUDENTS

(1) ν, Family order n, Completed size	(2) $N(\nu)$ College students	(3) $\varphi(n)\cdot N(1)$ Percentage of estimated completed fraternities	(4) $\varphi'(n)$ Completed fraternities in sample	(5) $\varphi'(n)/n\Sigma\frac{\varphi'(n)}{n}$ Weighted percentage distribution of completed fraternities
1	707	42.0	275	36.5
2	455	23.8	457	20.5
3	265	17.6	410	18.0
4	125	7.2	247	8.0
5	68	3.0	147	3.8
6	37	1.4	92	2.0
7	26	2.1	50	1.0
8	8	...	30	0.5
9	1	....	20	0.3
10	9	0.5	13	0.2
11	5	0.3	10	0.1
12	3	0.2	8	0.1
13	1	0.1	4	0.04
14	....	....	1	0.01
Sum	1,800	100.0	1,600	99.9
Average size		2.3		2.3

nities still vary in their dates of founding. The method of this paper assumes that $\varphi(n)$ and m remain constant with time, but this is far from true for large $\varphi(n)$ if the birth rate is undergoing rapid changes. Of the estimated mean fraternal size in a population with a changing birth rate it may be said that while it is not the mean size at the time of birth of the propositus children, it lies between this size and the mean size at the mean time at which the families of these children were being started.

In a population having over four-fifths of completed fraternities of size five or less (Table I) the hazards of estimate would not appear to be very serious. In the test case of fraternities of college students, the estimated average size and the actual average size agree in the first decimal place, and the discrepancies in the estimated and actual distributions of fraternal sizes are not such as to suggest an influence of decreasing fecundity.

SYMBOLS EMPLOYED

$\varphi(n)$	proportional to number of fraternities which will be completed with n children.
N	number of children in sample.
$N(\nu)$	number of children in sample of birth order ν.
$\delta N(n)$	$N(n)-N(n-1)$.
m	estimated average size of completed fraternities.
$\varphi'(n)$	number of fraternities of size n in a sample of completed fraternities.
$p(n)$	$N(n)/N$, the proportion of n-th born children in sample.
σ	standard error of m.
S_n	standard error of $\varphi(n)$.

KARL PEARSON AND MATHEMATICAL STATISTICS

BY BURTON H. CAMP, *Wesleyan University*

The retirement of Karl Pearson as professor at the University of London and director of the Galton Laboratory marks the culmination of a most notable chapter in the development of statistics. From many parts of the world men and women have come to his laboratory to listen to his lectures and to conduct their own researches in his stimulating presence. His editorship of *Biometrika* has made for that journal its position of prime importance as a repository for contributions to theoretical statistics.

Before reviewing Pearson's mathematical work it is necessary to pay respect to his personal qualities as a teacher and a scholar. It would be impossible for one who has been in close touch with him not to feel compelled to do this, and in addition these qualities have an important bearing on a proper interpretation of his writings. First of all he is friendly. This is probably not appreciated to the degree to which it is true by those who have been only his readers, for there is much in what he has written that is caustic. His critics have been dealt with in severe and able language. Sometimes it has been obvious that this has been well deserved, when they saw only a little of what he meant and gave publicity to palpably incorrect interpretations or to naïve criticisms of his views. But sometimes it has not been deserved, or at all events not obviously deserved, and then of course it reflected adversely on its author, but it does not follow, as some may have supposed, that he is given to shallow judgment or that he is unkind. Rather, if I may apply an Americanism to so staunch a Briton, he is quick on the trigger. I once had a cowboy friend at Harvard who used to say that Cambridge was all right, but as for him, he preferred a country where there was "jest a little smell of gunpowder in the air, not enough to make it disagreeable, but jest enough to make everybody polite, one to the other." He would have loved the Galton Laboratory when Professor Pearson was about, and—this is the point of the story—the rest of us loved it too; for with the brilliant mind and its masterful repartee lives as warm and kind a heart as a teacher ever had. It cannot be said of him as of some that he is so engrossed in things scholarly as to leave out the human touch. Indeed, strange as it may seem, something which is almost the reverse of that is true: although one cannot be in his presence without recognizing that here is a distinguished person, one wants to be in his presence not because he is distinguished

but because he is lovable. Every year at the laboratory a reunion is held of such of his former associates and pupils as are near enough to come. What impresses the stranger most about these meetings is that these persons seem to have come to do honor not so much to the philosopher as to the friend.

At his laboratory there was truly an association of scholars. Although local students were there working for degrees, for the most part those who had come were working simply for the development of science. Professor Pearson was not only the acting head of his laboratory, but was vital in every one of its activities. Anthropologists, biologists, sociologists, psychologists, mathematicians and others were there together, each working on his own problem, and once, frequently twice, every day, Professor Pearson sat down with each individual and thought through his work with him. He was indeed so very helpful it was even embarrassing, for it is not always easy to show progress in research twice a day. Pearson is indefatigable. He arrived at the laboratory early in the morning before others were admitted and left long after others were excluded. He hurried through lunch and beat his staff back to the books. He did not attend the British Empire Exposition in 1924. It was only a ten minutes' ride from his office, but he said he did not have the time. He was even then, at age 67, working at home late at night. He was taking a month's so-called vacation in August, but carrying his work with him, and coming back to London once or twice a week.

He is painstaking in two important respects. First, his mathematics is essentially rigorous. I was somewhat surprised to find that this was so, for coming from a background of training in analysis and having read most of his papers, I had the feeling that his mathematics might be a bit on the hop, skip and jump order, but I found that although his writings did not always mention the fine points, still they were in his mind, and really had been taken care of. Secondly, his computation, though naturally accurate, was always thoroughly checked, and he has insisted on similar care among his associates. Much of Pearson's theoretical work will, of course, ultimately be rewritten, perhaps several times, but the voluminous tables which he and his staff have compiled will for the most part never be recomputed. It is a comfort to know that they are trustworthy. The problem of computing a truly reliable table is not the simple one which those who have not done it commonly suppose, and a prodigious amount of work, both of routine and of theoretical nature, has been done at the Galton Laboratory on tables. The following tables at least should be mentioned: *Tracts for Computers*, *Tables for Statisticians and Biometricians* (2 volumes),

Table of Twenty Place Logarithms, Tables of the Incomplete Gamma Function. In connection with the construction of the latter much theoretical work was done on the problem of interpolation (see also the following by Seimatsu Narumi, one of Pearson's pupils: "Some Formulae in the Theory of Interpolation of Many Independent Variables," *Tôhoku Mathematical Journal*, vol. xviii, pp. 309–321).

This account of Pearson's scientific activities will have to be restricted almost exclusively to the mathematical part, but, although probably his eminence is due primarily to his success as a mathematician, his contributions to other sciences have been very important indeed. It is difficult to do justice even to his mathematics without incursions into various other fields, as will be evident from some of the titles to be cited below. This is especially true of his papers in the *Draper's Company Memoirs.* The record of his work is scattered through many volumes. His writings in *Biometrika* alone total about 1,500 pages, not including papers under joint authorship and others obviously done under his immediate supervision. He has written no book on mathematical statistics. Many wish that he would do so, for his writings have a clearness of exposition hard to match and he has at his command a great wealth of illustrative material. Possibly now, after his retirement from the laboratory, this hope of his friends may be considered more favorably.

One of his most important early papers on statistics was "Skew Variation in Homogeneous Material," *Philosophical Transactions of the Royal Society*, A, vol. 186 (1895), pp. 343–415. This contains a complete exposition of his now well known frequency curves (the fundamental types). Other frequency curves have been suggested, such as the so-called Gram-Charlier series of Hermite's polynomials, which had been tabulated by Pearson in the guise of tetrachoric functions, and various generalizations of both types. For a time there was much discussion as to which sort of frequency curves was the most valuable. This was rather regrettable. Both the Pearson and Charlier types spring from natural assumptions and both are valuable aids in analysis. Although it is a striking fact that almost every natural frequency distribution can be fitted by one of Pearson's curves or by a few terms of Charlier's series, it does not follow that either of these systems comprises in some hidden sense a natural law, and prolonged argument as to which gives the better fit would not appear to be justified on that ground. Certain of Pearson's curves are, of course, coming into prominence now in another connection, namely as the theoretical forms which are satisfied by the sampling distribution of certain statistical parameters.

Pearson's discovery of the chi-square test of significance was published in the *Philosophical Magazine* in 1900 with tables, vol. 50, pp. 157–175. The theory as then announced was essentially sound and has been of great value. As pointed out by Fisher and others, that theory would better be modified if used otherwise than in the ideal case, that is, the case where the universe sampled is supposed known. This modification turns out to be quite simple fortunately, and, as clearly stated by Irwin in the *Journal of the Royal Statistical Society*, vol. 92 (1929), p. 264, it is not absolutely necessary. It is a matter of precisely what question in probability one wishes to solve. It should also be pointed out that, by using too fine a division, Pearson at first carried some of the implications of his theory to an unwarranted extreme.

The theory of sampling runs through many volumes of *Biometrika*. When this theory was developed the samples were supposed fairly large and for the most part the discussion had to do with the discovery of formulae for the standard deviations of various statistics, a very important matter which is basic to the whole theory of sampling. Pearson was not at that time interested in the modern question of small samples and again he sought usually a solution for the ideal case when the universe sampled was supposed known. Again it is true that the modern improvements are often made possible by shifting the questions in probability from the questions whose solution was sought by Pearson to similar but not exactly identical ones whose solution for small samples it is easier to obtain. These early papers of his on sampling are marked by a thoroughness and completeness that have not been fully appreciated. Together they form an admirable text on the foundations of the subject. Latterly he has contributed to the small sample theory. This he thinks of as valuable but not so valuable as it sometimes appears. It should not, he thinks, be swallowed whole:

> Experimental work of a very useful kind has been started to discover how far the present mathematical theory of small samples can be extended to other than a single type of parent-population; but it is too early yet to be dogmatic as to the limits within which the application of such theory is valid. In particular I hold that the so-called "z" test as usually applied to small samples, especially when it is used to measure the probability or improbability of identity in the constants of small correlated samples, really requires further consideration. (1931.)

The idea involved in the coefficient of correlation was initially due to Galton, and it was originally called Galton's function, but Pearson's work on the development of this theory has been so important that the coefficient is now commonly known as his. The following papers should be mentioned here: "Regression, Heredity, and Panmixia," *Philosophical Transactions of the Royal Society*, A, vol. 187 (1896), pp.

253–318; "On the Influence of Natural Selection on the Variability and Correlation of Organs," same journal, A, vol. 200 (1903), pp. 1–66; "Novel Properties of Partial and Multiple Correlations," *Biometrika*, vol. 11 (1915–17), pp. 231–238. Pearson has investigated also other measures of interrelation such as the coefficient of contingency; *e.g.*, "On the Theory of Contingency and Its Relation to Average and Normal Correlation," *Draper's Company Research Memoirs*, Biometric Series, vol. 1 (1904). These other coefficients are not so valuable as the coefficient of correlation, however, and the same is true of various coefficients advocated by others, and Pearson has been forced to spend a good deal of labor in proving this. His tetrachoric "r" is theoretically the best measure of interrelation in a fourfold table, being in fact the very "r" of that normal surface which precisely fits the table. For many years it suffered in popularity because of the difficulty in its computation. That difficulty is now completely removed with the publication in 1931 of his second set of Tables (*cf.* also *Biometrika*, vols. 11, 19, and 22). The problem of polychoric "r" is still in a less satisfactory state (*cf.* an article by K. and E. S. Pearson, *Biometrika*, vol. 14, pp. 127–157), and it is especially because of this fact that the coefficient of contingency is used, but the latter is an unsatisfactory substitute, partly because it does not depend on the order in which the columns (or rows) of the correlation table are arranged. In this connection it is pertinent to note that at an early date Pearson recognized the error in dealing with a merely ordered series as if it were measured, by the method of assigning to it arbitrary numbers, and emphasized as the only scientific basis of measurement the method of graduation by means of a normal curve. This method lies at the foundation of much of the technique of the psychologist and the educationalist and the use of the Kelly-Wood table and others.

Pearson has been much interested in the history of statistics and is an avid reader of the early masters of the theory of probability, Bernoulli, Laplace, and others. It was by a brilliant inference that he found a rare appendix to a volume of De Moivre which showed that De Moivre and not Gauss or Laplace was the real author of the normal law, in the sense that De Moivre first gave the relation between this exponential function and the point binomial of probability theory.

The above paragraphs have to do with Pearson's thoughts on some matters that are familiar to all of us. For the rest it is perhaps sufficient to pick out from a large number half a dozen subjects with brief references for each, merely to indicate the variety of his interest in mathematical statistics: Probability that two samples belong to the same population, *Biometrika*, vols. 8, 10, 24, 25; hypergeometric series,

simple and double, *Biometrika*, vol. 16 (*cf.* also Romonovsky, vol. 17); bivariate surfaces, *Biometrika*, vol. 17 (*cf.* also Rhodes, vol. 14, Narumi, vol. 15); properties of Student's *z*, *Biometrika*, vol. 23; ranked individuals, and ranked variations, vols. 23 and 24. His earlier work in the fields of engineering and of mathematical astronomy is also important, but would not particularly interest readers of this JOURNAL.

Pearson has given much of his energy to the study of eugenics and anthropology, and although these are not our primary interest, they are too interesting to omit altogether. To quote from the University College Magazine:

> In the field of Eugenics, he has ever stressed the importance of the careful collection of information before any valid theories can be formed. *The Treasury of Human Inheritance* which has been published in a number of parts, represents the first and still the only attempt in England to provide material on an adequate scale for the study of human genetics. His contributions to the scientific study of physical anthropology have been perhaps as great as those of any other man. A recognition of their value was shown in 1932 when the Rudolf Virchow Medal was presented to him, the only anthropologist not a German to have received this honor. His contributions to medical knowledge were also recognized when he was made an Honorary Fellow of the Royal Society of Medicine, a very unusual honor for a layman, while he is the only man outside the insurance world to be a member of the Actuaries Club. The year 1930 saw the completion of the third and last volume of a great labor of love, *The Life and Letters of Francis Galton.* Those who glance at even a portion of it will begin to understand, not only what Galton was, but what Karl Pearson has been and is.

Pearson's scientific achievement is thus another excellent illustration of the old truth that progress in both mathematics and practical science is specially fostered when they are permitted to interact the one on the other. The modern mathematical theory of statistics apparently owes its existence to the need for solving practical problems in the theory of inheritance, and much of modern biometry would not exist if this study had not elicited the interest of a mathematician. At this moment a committee of the American Statistical Association is at work on the problem of how best to nurture in this country the development of mathematical statistics and how to supply mathematical tools to the so-called practical statistician. It would appear that the story of Pearson might give the best possible solution, namely the founding for scholars in this country of a laboratory similar to his, with a mathematician of his promise who will study all their problems with them. If the latter objective appears too difficult to realize, it affords for that very reason a striking commentary on what he has accomplished.

Professor Pearson retires after forty-two years of service at University College and twenty-four years as the head of the Galton Labora-

tory, this position having been transferred to him by Sir Francis Galton two years before his death in 1911. Pearson's position is now being shared by his son, Egon Pearson, who is head of the department of statistics at University College, and by R. A. Fisher, who is Galton Professor of Eugenics and in charge of the Galton Laboratory.

CRITERIA OF DIFFERENTIAL MORTALITY

By Harold F. Dorn and Samuel A. Stouffer

In general, students of social phenomena have two possible ways of reporting the results of their investigations. They may report their findings as unique historical facts which they have observed without attempting to draw any generalizations from them. Thus, the vital statistician studying differential urban and rural mortality might report a rural death rate of 9 per 1,000 and an urban death rate of 10 per 1,000; whether or not this difference was significant would not concern him, since he is merely reporting an observed historical fact. More often, however, the other alternative is followed and the results are reported, not as unique historical events, but as the basis of generalizations which may be applied to other than the data under immediate observation. It is quite obvious that the latter procedure involves a much more careful and critical analysis of the data than the former; for, while the fact that the urban mortality rate was found to be 1 per 1,000 greater than the rural at some particular time may be very interesting historically, it is of little value in formulating a public health program until it is known whether or not this represents significantly different mortality conditions and is likely to be repeated again.

It should be observed that in actual practice these two ways of procedure are frequently confused. The results of a study are often reported as historical facts but with a sort of implied inference that the observable differences or similarities are significant. In many cases the original data are not published but only the calculated averages, percentages, or other constants, so that the reader is forced to conclude that the study must be rejected with the verdict "not proven" or to accept it at its face value. Since the latter is the course usually adopted, especially if one is writing a textbook, it follows that conclusions are often based on differences which are statistically insignificant in the sense that chance alone could have produced them.

By chance is meant, of course, not something occult and mysterious, but merely the operation of a large number of small independent causes whose effects tend in the long run to cancel each other. The minor causes subsumed under the name of chance are presumably of the same sort as a major factor such as malnutrition or insanitation, but they are individually of so small importance and cancel each other's effects to such extent that it is either impossible or not worth while to attempt

to enumerate them. Sometimes, however, they give the superficial impression *that a major factor is more important than it really is.*

The usual method of determining differential mortality is to compute the respective death rates and estimate by inspection whether or not they differ significantly. None but the tyro in statistics considers comparing crude death rates of communities with unlike age, sex, nativity, or racial composition. But if the specific death rates by age and sex are computed for the separate nativity or racial groups, not only is it difficult to summarize the results in brief, concise terms, but the errors in the rates are frequently so large as to be misleading. It is customary to report the death rates from specific diseases per 100,000 so that large differences in the rates may not be significant if the base population is less than that number. If the base population is 10,000 and the rate is reported per 100,000, a difference of one death will cause a difference of 10 in the death rate. Such a situation is not so infrequent as one might suppose if age specific rates are being computed. *Even if the total population under consideration is well over one million* in number, the population in certain of the age groups will be considerably less than 100,000 and, in the older age groups, may be as small as 10,000. The 1930 census of population reported 1,802,976 urban native white males in Ohio but the number at age 75 and over was only 19,201, so that the difference between two death rates of 125 and 130 per 100,000 if computed for the urban native white males in Ohio at age 75 and over and for native white males in some other population of about the same size could be due to a difference of only one death. Yet one would be tempted to consider such a difference significant if reported in an array of age specific death rates.

Conciseness of summary is often achieved by the computation of standardized or adjusted rates. These do not, as has sometimes been supposed, represent the true mortality conditions in any population but are average death rates weighted so as to give equal importance to differences in age, sex, or some other factor in the populations under investigation. Obviously these rates will vary with the weights taken as a standard and should be interpreted as index numbers rather than as mortality rates, since they represent what the mortality rates would be in two populations with unlike age or sex composition if these factors were the same in both, other conditions remaining constant.

There are two drawbacks in using standardized death rates as criteria of differential mortality. Since they are weighted averages they are subject to the disadvantages of any average, particularly in that they tend to obscure variability. The aged might be dying in excess in one population and the young in excess in another population

but the two standardized death rates could still be the same since these influences would tend to cancel each other in an average rate. Our conclusion that, on the average, mortality conditions were the same in the two populations would be true but misleading. Unless mortality conditions tend to be uniformly worse at all ages in one population than in another, standardized rates may frequently obscure interesting differences.

Even if standardized rates are computed, the problem still remains of determining whether or not the difference between these rates is significant. Suppose that standardized rates of 8 per 1,000 for the rural population and 10 per 1,000 for the urban population are reported, are mortality conditions worse in urban than in rural communities? If these rates were based on populations of 1,000,000 each, there would be little hesitation in saying that mortality conditions were significantly worse in urban communities; if the base populations were 10,000 each, there probably would be some doubt as to whether or not the difference was important; and if the base populations were but 1,000 each, considerably less confidence would be placed in the rates. If some persistent questioner demanded a reason for this discrimination, the answer would be that the numbers were so small in the latter case that wide fluctuations might easily occur. But why should wide fluctuations be expected? Partly from a worship of large numbers, partly from experience, and partly from a "general feel for the data." If the questioner were inclined to be skeptical he probably would require more objective criteria, for different people might have different experiences and consequently a different "feel for the data."

We shall consider two such criteria: First, the well known chi-square test; and, second, a more sensitive test, based on sums and differences of differences, which we have not seen presented elsewhere, though it may have escaped the writers' notice.

The first method is the chi-square test for goodness of fit, originally developed by Karl Pearson and later modified and extended by R. A. Fisher and others.[1] The number of observations in any cell of a manifold classification is compared with the number expected by some hypothesis and the probability of the occurrence of a discrepancy

[1] For a discussion of the test see: G. U. Yule, *An Introduction to the Theory of Statistics*, 9th ed., 1929, pp. 370–389; R. A. Fisher, *Statistical Methods for Research Workers*, 4th ed., 1932, Chap. IV; L. H. C. Tippett, *The Methods of Statistics*, 1931, Chap. IV. An excellent proof and discussion of the test is given by T. C. Fry, *Probability and Its Engineering Uses*, 1928, Chap. IX.

In this connection where chi-square is used to test for independence alone, see especially: R. A. Fisher, "On the Interpretation of χ^2 from Contingency Tables and the Calculation of P," *Journal of the Royal Statistical Society*, pp. 85, 87–94, 1922; G. U. Yule, "On the Application of the χ^2 Method to Association and Contingency Tables with Experimental Illustrations," *Journal of the Royal Statistical Society*, pp. 85, 95–104, 1922.

as large or larger than the one observed is computed. If x_i is the number expected and f_i is the number observed in the i-th cell, then

$$\chi^2 = \sum_{i=1}^{m} \left[\frac{(f_i - x_i)^2}{x_i} \right]$$

where m is the number of cells.

An important application of the method is in testing for independence in association or contingency tables. An example of this class of tables is the classification of a population as urban or rural and a reclassification of each of these groups as dead or living. This particular illustration yields a four-fold table; the classification, of course, may be many fold. In testing for independence we assume that the frequencies in the body of the table will be distributed at random with the restriction that they must add up to the marginal totals. The expected values are calculated from the marginal totals observed; in the case of a four-fold table only one such value need be computed since the others may be written down immediately by subtraction from the margins. If f_1 and f_2 are the two observed frequencies and s_1 and s_2 are the corresponding totals [1]

$$\chi^2 = \frac{(P_1 - P_0)^2}{P_0 Q_0 \left(\frac{1}{s_1} + \frac{1}{s_2} \right)} \quad \text{where} \quad \begin{aligned} P_0 &= (f_1 + f_2)/(s_1 + s_2) \\ Q_0 &= (1 - P_0) \\ P_1 &= (f_1/s_1) \end{aligned}$$

The value of P is determined by entering the table of chi-square with n, the number of degrees of freedom, equal to the number of cells that may arbitrarily be filled in. In the case of a four-fold table n is taken equal to one when we are testing for independence.[2]

Since we do not know the true differential between urban and rural mortality, we may test the hypothesis that there is no real difference and estimate the probability of drawing two samples with the observed discrepancy from such a population. Small values of chi-square indicate that our hypothesis is approximately correct, while large values

[1] Fisher, *op. cit.*, pp. 89, 90.

[2] P represents the probability that any given value of chi-square shall exceed any specified value. As chi-square varies from zero to infinity, P varies from one to zero. The relation between them is complex and may be found in tables. Yule, *op. cit.*, p. 388, gives a table when n equals one. Fisher, *op. cit.*, gives a more extended table. In using Elderton's Table in *Tables for Statisticians and Biometricians*, Part I, pp. 26–28, it should be noted that, in this connection, the table should be entered with n' equal to n increased by unity. This table was computed for the case where the theoretical distribution is made to agree with the observed data only in respect to its total, and n' was taken equal to the number of cells. Fisher has since shown that when we are testing for independence and placing the restriction that the marginal total must also agree that the table may still be used by setting n' equal to n increased by unity.

A convenient rule for determining the number of degrees of freedom when r is the number of rows and c is the number of columns is $n = (r-1)(c-1)$.

indicate the contrary. Since the chi-square test measures either agreement or lack of agreement with some hypothesis and not the degree of this relation, only certain values of P are pertinent to our investigation. It seems reasonable to consider any value of P greater than .05 as not disproving our hypothesis, values between .05 and .01 as indicating possible disagreement, and values less than .01 as showing that our hypothesis is probably false.

The test indicates discrepancies of any kind, whether due to errors in the collection of the data, clerical errors in copying, or to factors pertinent to the study; consequently, the evaluation of the results depends upon the investigator. It might be shown that urban mortality conditions were significantly worse than rural mortality conditions in the sense that the chances were very small of drawing two samples with the observed discrepancy from a population in which there was no difference between urban and rural mortality conditions as shown by the number of deaths, but before we could place much confidence in the result, we should have to satisfy ourselves that our data were reasonable estimates of the actual situation. This, however, is true of any investigation; for not only are the data we collect at best only indicia of the material which we wish to investigate and involve the consideration of whether or not they are valid indicia, but also it must be shown that the data are reasonably accurate.

TABLE I

DEATH RATES PER 1,000 NATIVE WHITE POPULATION BY AGE AND SEX WITH CORRESPONDING VALUES OF CHI-SQUARE, URBAN AND RURAL, OHIO, 1930 †

Age	Male			Female			
	Urban	Rural	χ^2_m	Urban	Rural	χ^2_f	$\chi^2_m+\chi^2_f$
0– 4	17.1	16.5	1.40	14.0	13.8	.08	1.48
5– 9	2.2	1.9	3.71	1.4	1.5	.20	3.91
10–14	1.5	1.4	.20	1.1	1.3	2.52	2.72
15–19	2.5	2.2	1.84	1.9	2.1	.75	2.59
20–24	2.8	3.6	10.78**	2.7	3.4	7.24*	18.02*
25–29	3.2	3.7	2.30	3.3	3.0	.80	3.10
30–34	4.1	3.4	6.17**	3.6	3.8	.34	6.51**
35–44	5.9	4.9	15.40*	4.8	4.7	.55	15.95*
45–54	11.4	7.6	99.07*	9.6	8.0	17.82*	117.40*
55–64	24.7	16.8	148.17*	19.2	16.6	18.58*	166.75*
65–74	57.3	43.8	108.77*	44.7	40.3	13.56*	122.33*
75 and over	138.8	117.8	42.77*	116.0	121.7	.85	43.62*
Total	9.9	11.0	441.27*	8.8	10.5	63.29*	504.56*
Adjusted rate	10.4	8.7		8.0	8.3		

† See this JOURNAL, Vol. XXVII, No. 180, pp. 401–12, for the original data on which these rates are based.
* *Indicates a value of P less than .01.*
** Indicates a value of P between .01 and .05.
For other values of χ^2, P is greater than .05.

The computation may be made using proportions or the absolute frequencies. In the latter case the formula becomes

$$\chi^2=\frac{(f_1-s_1P_0)^2}{P_0Q_0}\left(\frac{1}{s_1}+\frac{1}{s_2}\right).$$

Using the data for males 0–4 years of age

	Dead	Living	Total
Urban	3,006		175,474
Rural	1,671		101,102
	4,677		276,576

Note that it is not necessary to fill in the column headed "Living."

$$\chi^2=\frac{(3006-2967.3286)^2}{(.016910)(.983090)}\left(\frac{1}{175{,}474}+\frac{1}{101{,}102}\right)=1.40$$

$$P_0=\frac{4677}{276576}=.016910.$$

Considering the death rates per 1,000 native white population for males, rural and urban, we notice (Table I) that the urban rates are higher than the rural rates for all ages except 20–29 years. While the urban crude rate is less than the rural crude rate, the opposite is true when allowance is made for differences in age composition as shown by rates (adjusted on the basis of the standard million population of England and Wales of 1901) of 10.4 and 8.7 respectively. The application of the chi-square test shows that the difference is insignificant until the age group 35–44 years, with the exception of ages 20–24 and possibly 30–34, although in the latter group the evidence is not conclusive according to the criteria of significance previously mentioned.

Referring to the rates for females, the rural rates are higher than the urban rates for ages 5–34, while the urban rates are higher at the other ages. This case illustrates the point discussed above in connection with standardized rates. Since mortality conditions for females are not uniformly worse at all ages in urban communities as compared with rural communities, the corresponding *standardized rates* show very little difference, being 8.6 and 8.3 respectively. Applying the chi-square test significant differences are noted at ages 20–24 and 45–74.

Having determined at what ages there is a significant difference between urban and rural mortality conditions we now seek a method of combining this information into a summary figure so that we may

answer the question: Is there a significant difference between urban and rural mortality rates after making allowance for age composition? This may be done by adding the values of chi-square for the separate age groups.[1] This procedure is valuable in that it will show up discrepancies which are too slight to be revealed at any given age group. The number of degrees of freedom is equal to the sum of the degrees of freedom corresponding to the values of chi-square used.

For the males the total chi-square secured in this manner is 441.27 and entering the table of chi-square with n equal to 12, P is less than .01. This we interpret as indicating that there is a significant difference between urban and rural mortality conditions as shown by the number of deaths after making allowance for differences in age composition. Corresponding values for the females are 63.29, n equal to 12 and P is again less than .01. The same interpretation also holds.

The values of chi-square may be added for each age group and for all ages. The former addition enables us to determine the ages at which *urban and rural mortality are significantly different after making* allowance for sex variability, while the latter is a summary of all the data in the table and yields a value of chi-square taking into consideration both age and sex. This value is 504.56, n equals 24, and P is less than .01. The interpretation is that urban or rural residence is a differentiating factor in mortality even after making allowance for differences in age and sex composition. This application of the test is somewhat different than that proposed by Karl Pearson.[2]

In like manner we could test the urban and rural foreign-born white and colored mortality rates. From such computations a total chi-square could be obtained indicating whether or not, after taking into consideration differences in age, sex, nativity and racial composition there exists a significant difference between urban and rural mortality conditions. But this is not the question which we are most interested in answering. We want to know not only whether or not urban mortality conditions are *different* from rural mortality conditions, but also whether or not urban mortality conditions are *worse* than rural mortality conditions. Since chi-square is a squared quantity, any difference may be either in excess or in deficit, the value of chi-square being the same in both cases. *Of course, for any single age group inspection* of the rates will indicate which of the two is the greater, but there is another method available which not only indicates the nature of the

[1] Fisher, *op. cit.*, p. 83.

[2] Karl Pearson, "On the Theory of Multiple Contingency with Special Reference to Partial Contingency," *Biometrika* 11, 145–158.

——— and J. F. Tocher, "*On Criteria for the Existence of Differential Death Rates*," *ibid.*, pp. 159–184.

difference but also enables us to answer some further questions which we may wish to ask.

It should be apparent that in the case of a four-fold table the chi-square test is an extension of the ordinary method of finding the significance of the difference between two binomial means, with the important property that the information for several such tests may be combined. That this is true may be seen from Table II, columns 1 and 2. These values were computed by the usual method of finding the significance of the difference between two proportions.[1]

It will be noted that the values in columns 1 and 2 of Table II are the square roots of the corresponding values of χ^2_m and χ^2_f in Table I. The proper sign may be attached to the values in Table II. It is now readily apparent that at ages 20–24 the rural mortality rate is significantly greater than the urban mortality rate for both males and females but that the urban mortality rate is significantly greater than the rural mortality rate from age 35 and over for the males and from ages 35–74 for the females. We take the same criteria of significance as before.

Suppose that we wished to answer the following questions: At what ages is the urban mortality rate greater than the rural mortality rate after making allowance for differences in sex composition, and, is the difference between urban and rural mortality rates greater for males than for females? We may proceed as follows:

Let ${}_uR_m$ equal the urban male mortality rate, based on s_1 cases,
${}_uR_f$ equal the urban female mortality rate, based on s_1' cases,
${}_rR_m$ equal the rural male mortality rate, based on s_2 cases,
${}_rR_f$ equal the rural female mortality rate, based on s_2' cases,
then $({}_uR_m - {}_rR_m)$ has a variance of $p_0q_0(1/s_1+1/s_2)$
and $({}_uR_f - {}_rR_f)$ has a variance of $p_0'q_0'(1/s_1'+1/s_2')$.

$({}_uR_m - {}_rR_m) - ({}_uR_f - {}_rR_f)$ has a variance of the sum of their separate variances. We are testing the hypothesis that $({}_uR_m - {}_rR_m) - ({}_uR_f - {}_rR_f)$ is zero. If this hypothesis is true then $p_0q_0 = p_0'q_0' = P_0Q_0$. In most cases we do not know the value of P_0Q_0. In the absence of any

[1] $\dfrac{P_1-P_2}{\left[P_0Q_0\left(\dfrac{1}{S_1}+\dfrac{1}{S_2}\right)\right]^{1/2}}$. An alternative formula is $\dfrac{P_1-P_2}{\left[\dfrac{P_1Q_1}{S_1}+\dfrac{P_2Q_2}{S_2}\right]^{1/2}}$.

The difference between these two formulas is usually slight, but a somewhat more stable estimate of the unknown standard deviation is probably given by the former.

The computation for the males aged 0–4 years is (referring to the footnote to Table I):

$$P_1=\frac{3006}{175{,}474}=.017131;\ P_2=\frac{1071}{101{,}102}=.010528;\ \frac{.017131-.010528}{\left[(.016610)\,(.083090)\left(\dfrac{1}{175{,}474}+\dfrac{1}{101{,}102}\right)\right]^{1/2}}=1.10.$$

better estimate it would seem reasonable to take $P_0=(s_1+s_2)p_0+(s_1'+s_2')p_0'/(s_1+s_2+s_1'+s_2')$ and $Q_0=1-P_0$. Hence take

$$\frac{({}_uR_m-{}_rR_m)-({}_uR_f-{}_rR_f)}{[P_0Q_0(1/s_1+1/s_2+1/s'_1+1/s'_2)]^{1/2}}\text{ as a normal deviate.}$$

In the same way we may test the sum of the differences since the variance will be the same in both cases.[1]

We are now prepared to answer the question: Is the urban mortality rate greater than the rural mortality rate after making allowance for sex differences? Referring to Table II, column 3, we see that making allowance for differences in sex composition the urban rate is significantly greater than the rural rate at age 35 and over, while the rural

TABLE II

VALUES OF THE RATIO OF THE DIFFERENCE BETWEEN TWO PROPORTIONS TO ITS STANDARD ERROR FOR URBAN AND RURAL MORTALITY RATES OF THE NATIVE WHITE POPULATION BY AGE AND SEX, OHIO, 1930

Age	$({}_uR_m-{}_rR_m)$ (1)	$({}_uR_f-{}_rR_f)$ (2)	$({}_uR_m-{}_rR_m)+({}_uR_f-{}_rR_f)$ (3)	$({}_uR_m-{}_rR_m)-({}_uR_f-{}_rR_f)$ (4)
0- 4	1.10	.27	1.05	.68
5- 9	1.03	− .44	1.18	1.75
10-14	.45	−1.58	− .73	1.30
15-19	1.36	− .80	.40	1.58
20-24	− 3.28*	−2.09*	− 4.22*	− .41
25-29	− 1.54	− .80	− 1.72	− .45
30-34	2.48**	− .58	1.38	2.10**
35-44	3.02*	.74	3.30*	2.35**
45-54	9.98*	4.22*	10.09*	4.20*
55-64	12.05*	4.31*	11.70*	5.88*
65-74	10.43*	3.08*	10.10*	5.20*
75 and over	6.54*	− .02	4.25*	5.40*

* Indicates a value of P less than .01.
** Indicates a value of P between .01 and .05.
For other values, P is greater than .05.
P indicates the probability of a chance difference greater than that observed regardless of the algebraic sign of the difference. The probability of a difference greater than that observed and having the same algebraic sign would be ½ P.

[1] This is only one of several slightly different ways in which the test may be made. Instead of P_0Q_0, some other estimate might be used; and, under certain conditions, it might be advisable to use weights. For example, the difference, $({}_uR_m-{}_rR_m)$, might be given a weight, $W_1=\left(\frac{1}{S_1}+\frac{1}{S_2}\right)^{-\frac{1}{2}}$, and the difference, $({}_uR_f-{}_rR_f)$ be given a weight, $W_2=\left(\frac{1}{S_1'}+\frac{1}{S_2'}\right)^{-\frac{1}{2}}$. Then the variance becomes $P_0Q_0\left\{W_1^2\left(\frac{1}{S_1}+\frac{1}{S_2}\right)+W_2^2\left(\frac{1}{S_1'}+\frac{1}{S_2'}\right)\right\}$ which reduces to $2P_0Q_0$. The ratio of the weighted sum to its standard deviation is not likely to differ markedly from the ratio of the unweighted sum to its standard deviation unless the values of S differ markedly. In the last age group of Table II, 75 and over, $S_1=10,061$, $S_2=24,838$, $S_1'=27,313$, $S_2'=23,700$. The ratio based on the unweighted sum was 4.25; the ratio based on the weighted sum was 4.03; a discrepancy of only 5 per cent, which is negligible. This was the largest difference in any age group in Table II.

The reader should keep clearly in mind the difference between the hypothesis here tested and that which was tested earlier by using the simultaneous distribution of χ_1^2 and χ_2^2. The χ_1^2 and χ_2^2 method has a wider generality, but in the particular application made in this problem does not give as full and decisive information as the procedure just discussed.

rate is significantly greater than the urban rate for the age group 20–24 years. Column 4 indicates whether or not the difference between urban and rural mortality conditions is greater for males than for females. The difference is greater for males at age 45 and over; this is very likely also true for the ages 30–44, but the evidence is not conclusive.

Our tests have indicated whether or not differences in urban and rural mortality rates could be due to age or sex as the case may be. If we had considered some other factor the results might very well have been otherwise. But after determining whether or not age and sex may explain the differences in mortality we are in a better position to investigate the influence of other factors.

The computation for the age group 0–4, Column 3 is as follows:

	Males		Females	
	Dead	Total	Dead	Total
Urban..............	3,006	175,474	2,375	170,113
Rural..............	1,671	101,102	1,338	96,733
	4,677	276,576	3,713	266,846

$$ {}_uR_m=\frac{3006}{175,474}=.017131;\ {}_rR_m=\frac{1671}{101,102}=.016528;\ {}_uR_f=\frac{2375}{170,113}= $$

$$ .013961;\ {}_rR_f=\frac{1338}{96,733}=.013832; $$

$$ P_0=\frac{4677+3713}{276,576+266,846}=.015439;\ Q_0=.984561 $$

$$ \frac{(.017131-.016528)+(.013961-.013832)}{\left[(.015439)(.984561)\left(\frac{1}{175,474}+\frac{1}{101,102}+\frac{1}{170,113}+\frac{1}{96,733}\right)\right]^{1/2}}=1.05. $$

The statement that the difference between certain of the mortality rates is insignificant in the sense that it might easily occur by chance should not be interpreted as meaning that chance in the popular sense actually did bring about the difference. From actual experience we know that this is not the case; chance, as such, is not on the approved list of the International List of Causes of Death. What we mean is that we could set up an *artificial population* in which there was no difference between urban and rural mortality rates and by purely random methods draw two samples with the observed discrepancy. Our

interpretation is that chance *could* account for the difference, not that chance actually *did* account for it.

Objection might be raised to the use of the normal probability curve when the original distributions are as skew as the ones with which we are dealing. But it should be remembered that we are not dealing with the original distributions but with the distribution of differences and these approach normality very rapidly even though the original distributions are very asymmetrical. As an empirical test of the theory, the value of β_1, was computed for the following:

$n_1 = 8{,}274$	$n_2 = 18{,}474$
$p_1 = .001208005$	$p_2 = .001136733$
$q_1 = .998791305$	$q_2 = .998863267$

The result was .0228; for the normal curve the value is zero. Since n and p are both larger as a rule than the values used, the use of the normal probability curve seems justified so long as we do not interpret the probabilities too strictly.

There are several important limitations on the use of these techniques. The use of the chi-square test assumes that the deviations in each cell are normal. This is true only when the frequencies are not too small.

The chi-square test, of course, ignores the sign of the difference. This is remedied by employing the second test proposed although this latter does not possess the generality of the chi-square test.

Neither of the tests gives any information as to the strength of the association. They test independence only, that is whether or not departures from independence may or may not be due to chance. It will be observed that the results depend upon the size of the sample. A smaller sample would give a lower significance for the same association while a larger sample would give a higher significance.

P in itself does not establish independence or the lack of independence. The hypothesis is true only in the sense that the observations would not be miraculous if it were true. There are no definite rules for the limits of independence but the values suggested above are probably as suitable as any for most purposes.

As with all applications of statistical techniques the formal application may be correct but the justification and interpretation of the results may be very difficult. Consequently the tests should not be applied blindly but with a full appreciation of their limitations as well as their powers of analysis.

Another limitation of the methods used for testing significance is the necessity of assuming that one death is independent of another. This,

of course, is not true in all cases, especially for deaths due to contagious diseases, influenza and pneumonia.

The value of chi-square which tested the significance of the difference between urban and rural mortality rates for all male deaths at ages 0–4 was 1.40, which is not significant. If we exclude deaths from contagious diseases, influenza and pneumonia, the value of chi-square is raised to 4.24 suggesting that the net urban mortality for males of this age group may be significantly slightly greater than the net rural mortality. Values of chi-square for the age groups 5–9 and 10–14 remained substantially unchanged after subtracting deaths from contagious diseases.

At present, no method is available for appraising the extent to which the factor of contagion vitiates the use of the tests proposed. Because of the small proportion which deaths from contagious diseases bear to the total, except in a year of severe epidemic or except in the very early age periods of life, the validity of the tests used would seem not to be greatly impaired. Even in the case of the age group 0–4, where the chi-square was altered by the subtraction of deaths from contagious diseases, it is an open question as to what extent the alteration was the result of contagion vitiating the original test or to what extent it was simply a result of the fact that the incidence of contagious diseases is different in urban and rural communities.

That the latter explanation is not to be disregarded is seen when the deaths from premature births are subtracted from all deaths in the age group 0–4. These deaths surely should be regarded as independent of one another. Yet the effect of subtracting deaths from premature birth is to show the net rural death rate slightly higher than the net urban rate, reversing the original differential (although neither before nor after subtracting these deaths is the difference statistically significant).

After a little experience with mortality rates, one soon reaches the point where differences which are so large as surely to yield significant probabilities can be determined by inspection. It would be unnecessarily meticulous to insist on the necessity of testing every difference numerically. The purpose of this paper is rather to substitute a set of logical procedures for rule-of-thumb methods in cases near the border line of significance. Logical procedures become increasingly important as the size of the sample decreases due to the use of sub-classification to hold constant several factors, such as age, sex, nativity, race, and size of community.

PREDICTING RELIEF CASE LOADS FOR MINNEAPOLIS BY EMPIRICAL PROCEDURES, 1932–1933

By F. Stuart Chapin, Ernst Jacobson, and Sarah Stone, *University of Minnesota*

The rapidly mounting poor relief load and the probability of a continuing number of dependents for years to come, make the analysis of this subject one of practical importance and theoretical interest. In this paper we present the results of two years of analysis by empirical procedures that continue and advance the analyses published in 1924[1] and 1926.[2]

Predictions of relief case loads made three to six months in advance of any calendar month are shown in columns (6) and (9) of Table I. It will be seen that our predictions for the months May through October, 1932, made in May, 1932, average 15.7 per cent below the observed. For November and December, 1932, the predictions made in August, 1932, were 9.95 per cent below and 12.35 per cent above, respectively, the observed values. By use of a more refined method of approximating the secular trend, the predictions made for December, 1932, and for January, February and March, 1933, were less than 2 per cent below the observed values. Although these latter predictions were made on January 14, 1933, they actually predict five months in advance, since the observed values of November and December were not available until after the middle of January, 1933.

Since the percentage of error is decreasing with an improvement in our technique and in any event the percentage of error is not so large but that the predictions may be useful to public administrators, we publish these results with a brief description of the method in the hope that they may be helpful to other statisticians and sociologists who are interested in the problem of predicting relief loads.

The data consist of total monthly case loads of families given relief by the Minneapolis Board of Public Welfare and the Minneapolis Family Welfare Association. Single men and women are not included. The unit is the family of two or more members. Since the average size of family in Minneapolis in 1930 was 3.2 persons the total number of individuals concerned may be approximated by multiplication.

[1] F. Stuart Chapin, "A dependency index for Minneapolis," *Publications of the American Sociological Society*, 1924.

[2] F. Stuart Chapin, "Dependency indexes for Minneapolis," *Social Forces*, V. no. 2, December, 1926, pp. 215–224.

TABLE I

TOTAL RELIEF CASES (FAMILIES) REPORTED BY MINNEAPOLIS BOARD OF PUBLIC WELFARE AND TOTAL RELIEF CASES (FAMILIES) OF FAMILY WELFARE ASSOCIATION BY MONTHS, 1929-1933

Month	1929	1930	1931	1932			1933		
				Number reported*	Predicted number	Difference from Col. 5	Number reported*	Predicted number	Difference from Col. 8
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
J.	1,550	2,035	4,330	7,174	....	....	13,265	13,047 (3)	−01.64
F.	1,726	2,242	4,545	0,483	....	....	14,005	13,835 (3)	−01.84
M.	1,033	2,130	4,500	0,083	....	....	14,502	14,300 (3)	−01.54
A.	1,520	2,020	4,085	0,315	....	....	14,172	14,009 (4)	−01.15
M.	1,252	1,608	3,837	8,150	7,005 (1)	− 0.05	13,073	13,323 (4)	+01.91
J.	1,216	1,502	3,710	7,073	7,015 (1)	− 8.40	12,382	13,323 (4)	+07.50
J.	1,128	1,528	3,073	8,180	0,848 (1)	−10.34	......	....	....
A.	1,112	1,577	3,107	8,700	0,730 (1)	−23.25	......	....	....
S.	1,100	1,048	3,470	0,457	7,242 (1)	−23.42	......	....	....
O.	1,170	1,015	4,248	9,080	8,285 (1)	−10.08	......	....	....
N.	1,503	3,080	5,446	10,709	0,043 (2)	− 0.05	......	....	....
D.	1,048	3,850	7,150	12,225	13,730 (2)	+12.35	......	....	....
					(3)	−00.35			

* Reported 40 days after expiration of calendar month.
(1) Predictions made in May 30, 1932, on secular trend of free-hand parabola unadjusted.
(2) Predictions extended in August, 1932, on same series.
(3) Predictions made January 14, 1933, on secular trend of $y=100-3.5X+0.204X^2$ deviations adjusted. Since on January 14, 1933, the report of the Department of Poor Relief for November was not yet available, the prediction of January 14, 1933, was for the 4-month period, D, 1932, J-F-M, 1933.
(4) Predictions made April 17, 1933, on (3) projected. Since on April 17, 1933, the report of the Department of Poor Relief for March, 1933, was not available, the prediction of April 17, 1933, was for the 4-month period M-A-M and J, 1933.

The year 1926 was taken as the base year and a relative series constructed on this base.

Our first step in the attempt to eliminate the secular trend of the relief index series was to draw in a free-hand parabola of the second order having regard for the general slope of the trend in a longer poor relief series beginning in 1915.[1] Consequently, the parabola used was drawn in consideration of longer time tendencies than those shown for the period 1926 to 1933. Next the deviations of the index series from the ordinates read off this free-hand parabolic trend were converted into sigma deviations and plotted in a curve similar to that shown for the relief index in Chart II. Since our first approximation to the secular trend was frankly taken as a rough approximation, no centering or adjustment was made, and our first predictions for May to November, 1932, were made from this secular trend. Even this rough method yielded predictions for a six-month period subsequently found to vary from the observations by an average of only −15.7 per cent. Since a free-hand curvilinear extension is not subject to verification and hence weakens the whole prediction technique, we fitted to the free-hand

[1] *Ibid.*, p. 217, Chart I, in which a linear upward trend was used. The free-hand parabola was drawn to provide a curvilinear extension of this long-term trend.

parabola, a square parabola of the form, $Y=100-3.5X+0.264X^2$, by the method of approximate three point suspension. In order to better our predictions, deviations from the square parabola were then centered. The final trend computed by this method is shown by the dotted line in Chart I.

CHART I

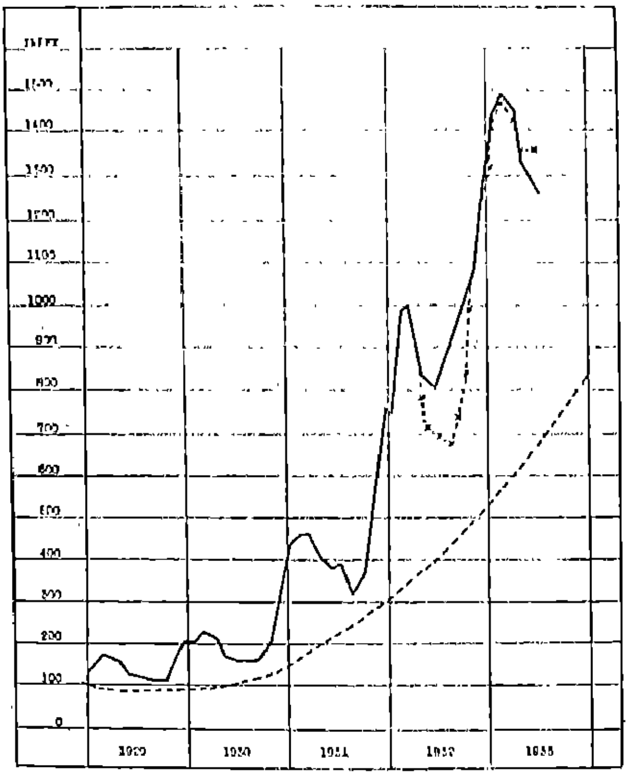
INDEX OF RELIEF FOR MINNEAPOLIS AND SECULAR TREND 1929–1933

1926 = 100 on Scale = 981 Cases

$Y=100-3.5X+0.264X^2$ (Origin, December, 1928)

x---x---x--- Predicted Index of Cases

———— Index of Reported Cases



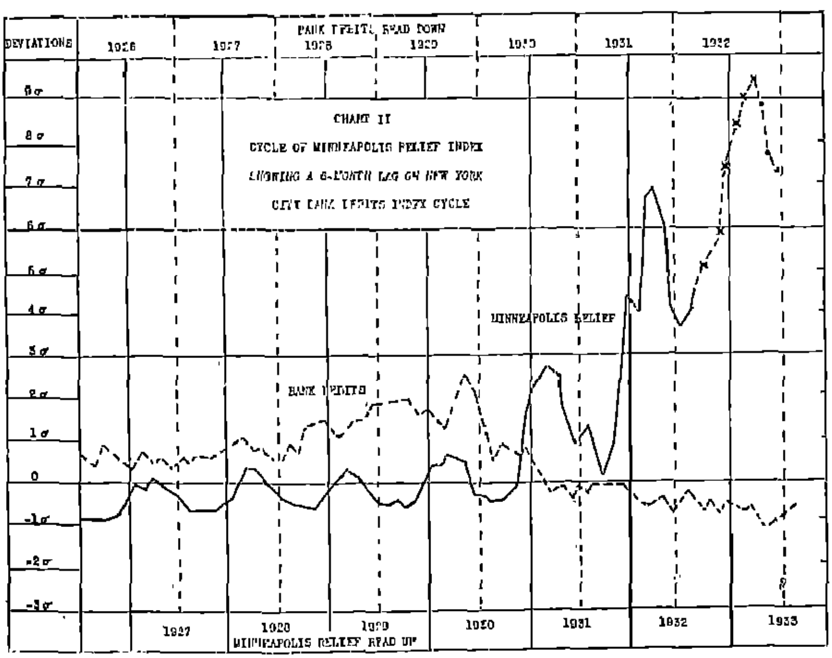
The cycle of poor relief, expressed in sigma deviations in Chart II, is derived from Chart I. It will be observed that we made no allowance for elimination of the seasonal factor. There were two reasons for this, first, a test of elimination by a mean-median method yielded a curve that behaved like a mirror image of the original index curve; and second, since seasonality is highly important and

of diagnostic value for the study of relief fluctuations, we desired to allow the seasonal factor to remain as a free variable. This procedure, a digression from the usual technique of time series analysis, appears to have pragmatic justification, since our predictions, made without mechanical allowance for seasonality, show consistently small errors.

The next problem was to discover an independent variable with sufficiently high correlation with the relief series cycle to admit of prediction. Six indices of business conditions in the Northwest[1] published by Kozelka were examined and discarded because of absence of sufficient lag to permit prediction. Next six indices of national business conditions were examined and, fortunately, the index of bank debits of New York City was found to supply the desired independent variable.[2] Correlations between the Minneapolis relief index and the New York City bank debits index gave $r = -.235$ with a 6-month lag for the period July, 1926, to December, 1931, of the relief index, and $r = -.527$ with a

CHART II

CYCLE OF MINNEAPOLIS RELIEF INDEX, PLOTTED WITH A 6-MONTH LAG OVER NEW YORK CITY BANK DEBITS INDEX CYCLE



[1] R. L. Kozelka, *Business Fluctuations in the Northwest*, University of Minnesota, 1932.

[2] *Monthly Review of Credit and Business Conditions*, Second Federal District Reserve Bank. The New York City bank debits index was converted into sigma deviations by $\frac{\text{Index}-100}{\sigma}$.

6-month lag for the period, January, 1926, to August, 1932, of the relief index. Chart II shows the relationship of the two series in cycle form with the lag indicated. Somewhat higher correlations on a 3-month lag were found as follows:

$r = -.370$ for the period January, 1926, to December, 1931, of the relief index;

$r = -.683$ for the period January, 1926, to August, 1932, of the relief index.

However, these lags were not used for two reasons: first, the 3-month lag was too short for practical prediction purposes because the observed totals of any given calendar month were not available until after the middle of the second following calendar month, thus making the 3-month lag impracticable; second, a 6-month lag provided a longer period of prediction and a stricter test of the technique.

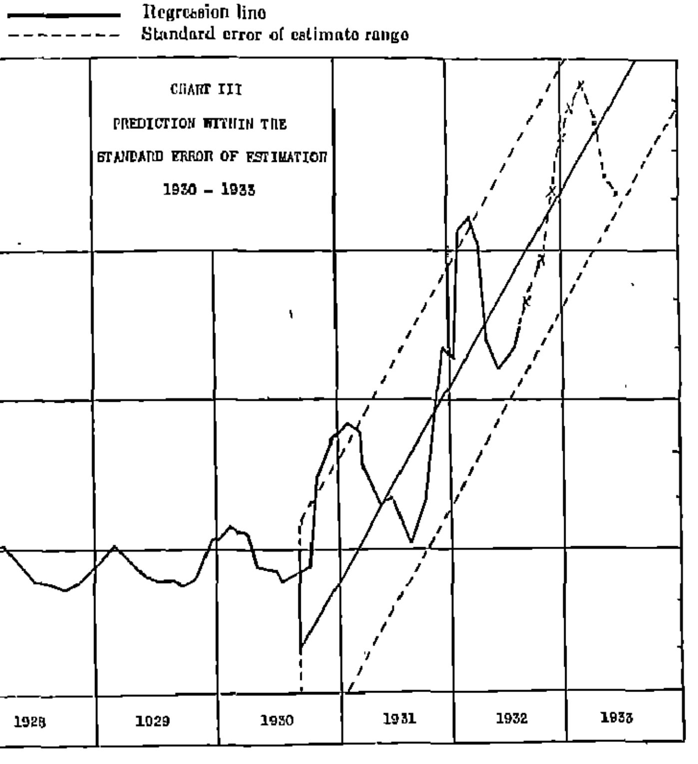
Up to this point we have described the steps of usual procedure in empirical analysis; the next point is something of a departure in procedure. It is frankly experimental and empirical and its justification at this stage of our research is wholly pragmatic, since it does work satisfactorily, although no mathematical basis is yet developed.

The problem of predicting monthly relief load is one of anticipating the main direction of the cycle underlying the monthly fluctuations and at the same time one of anticipating the seasonal fluctuations that occur with regularity as shown in Charts I and II. At this point we assume that the upward direction of the relief load cycle of Chart II will continue on the principle of a continued 6-month lag with the New York City Bank Debits Index. Having made this assumption, we then select a 24-month period ending with the last calendar month for which the Bank Debits Index is available and correlate this variable with a 24-month period of the relief index which is thus projected six months. For example, the Bank Index figures for the period March, 1930, through February, 1932, are correlated with the relief index figures for September, 1930, through August, 1932. A correlation of $r = -.626$ is obtained. From this and the sigma values of the correlation, we compute the values of the parameters of the regression equation, a and b. The value a is 2.06, and b is -4.07. It is now possible to plot this regression line as the upward direction of the relief load cycle as shown in Chart III. Next the standard error of estimate of this regression line is computed and found to be 2.06. Plotting in the range of this standard error of estimate in the form of the parallel dash lines of Chart III, we now have limits that serve as a guide in drawing the predicted seasonal fluctuations for the future six months. It is, of course, evident

that subjective factors enter in at this point. Aside from the limits of the standard error of estimate, there is only the pattern of previous seasonal fluctuations to serve as a guide. For the present only a pragmatic test is available. However, proceeding in this way we draw in the predicted monthly fluctuations for the next 5 or 6 months.

CHART III

PREDICTION WITHIN THE STANDARD ERROR OF ESTIMATION, 1930–1933



The next steps are merely routine computations, shown in Table II. Here we enter our prediction of a monthly index (expressed in sigma deviations) in the last right-hand column, or column 7. Then this value is multiplied by the value of the standard deviation; for example, taking January, 1933, we multiply 8.3 by 85 and enter the result, 705, in column 6, as the derived (*Y-O*) value that corresponds to the sigma deviation 8.3. Then this value is adjusted by adding 61, the figure that centers the curve, thus giving 766. Next we read off from the secular trend in Chart I, the value on the curve corresponding to the month of January, 1933. This value is 560. The sum of 766 and 560

gives us the derived value of the index for the month in question and this value of 1,320 is entered in column 3. The final step is to convert this index value into the corresponding absolute number of cases, which is done by multiplying it by 984 (the mean value of the base year 1926) and dividing the result by 100. This procedure leads to the figure 13,047 as our predicted total relief cases for January, 1933.

TABLE II

COMPUTATION OF PREDICTED CASES

Month	Predicted number of cases Col. 3 × 984÷100	Index on 1926 base Col. 4 + Col. 5 and 6	Value of ordinate O, of secular trend	(Y-O) values, or deviations from O adjusted, add 61	(Y-O) Values computed from Col. 7	Sigma values estimated by free-hand projection on Chart III
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1932						
M.	7,005	779	405	. .	374	3.5
J.	7,015	713	425	.	288	2.7
J.	6,818	690	410	. .	250	2.4
A.	6,730	681	400	.	224	2.1
S.	7,242	730	480		250	2.4
O.	8,285	812	500	.	342	3.2
N.	9,643	980	520	. .	460	4.3
D-1	13,736	1,396	540	. .	856	8.0
D-2	12,181	1,238	540	698	637	7.5
1933						
J.	13,047	1,320	560	766	705	8.3
F.	13,845	1,406	580	826	765	9.0
M	14,356	1,460	600	860	799	9.4
A.	14,009	1,432	632	800	739	8.7
M.	13,323	1,351	656	698	637	7.5
J.	13,323	1,354	681	673	612	7.2

Column 1.—D-1 is first estimate for December, 1932, based on estimate of sigma value 8.0 of Column 7; and D-2 is second estimate for December, see 7.5 in Column 7.

Column 2.—Predicted cases are obtained from entry in Column 3 multiplied by 984 (index of base year 1926) and divided by 100.

Column 3.—Index on 1926 base is derived from sums of entries in Columns 4 and 6 for March to D-1 of 1932; and the sums of entries in Columns 4 and 5 for December (D-2) of 1932 to June, 1933.

Column 4.—Value of ordinate O, of secular trend. For May to December (D-1) 1932 it was read off a free-hand parabolic trend; for December (D-2) 1932 to June, 1933, it was read off the parabola, $y=100-3.5X+0.204X^2$, fitted by a three point suspension method.

Column 5.—The adjusted (Y-O) values are obtained by adding 61 (the adjustment) to each entry in Column 6.

Column 6.—The unadjusted (Y-O) values or deviations of the ordinates of the series from the secular trend are computed by multiplying 107 (the standard deviation of the unadjusted series) against the estimated sigma values of Column 7 for May to D-1 of 1932; and for the period December (D-2) 1932 to June, 1933, using as the multiplier the value 85, which is the standard deviation of the adjusted series.

Column 7.—Sigma values estimated by free-hand projection within the range of the standard error of estimate of Chart III. From May to December (D-1) 1932, these values are derived by eliminating the secular trend by a free-hand and unadjusted parabola. These estimates were made in May, 1932, for May to October, and in August, 1932, for November and December. From December (D-2) 1932 to June, 1933, these values are derived by eliminating the secular trend by the parabola, $y=100-3.5X+0.204X^2$, fitted by a three point suspension method and the deviations adjusted. These estimates were made on January 14, 1933, for December (D-2) 1932 to March, 1933, and on April 17, 1933, for April to June, 1933. Since there is a delay of one and a half months in reporting the observed values, the estimates made in January were made without knowledge of the observed values of November or December, 1932, and hence were 5 months in advance.

The pragmatic test of our procedure lies in the degree of correspondence between the predicted totals and the totals subsequently reported. Table I, columns 7 and 10, displays the results of 14 months' predictions. Although our figures indicate some progress in the improvement of the technique, the whole procedure suffers from some fun-

damental limitations of both a practical and a theoretical nature. These will now be considered.

The greatest practical limitation is the total unpredictability of irregular fluctuations. Administrative changes in the distribution of relief such as, decision suddenly to reduce the amount of relief and thus greatly increase the capacity and resulting number of cases; change in policy in the other direction, whereby fewer cases are taken and more adequate relief given, thus diminishing the cases without reference to the natural increase; transfer of cases in large numbers to other agencies, such as the R. F. C. relief; these and other factors would effect changes in the trend and in the seasonal variations. Consequently the continued practicability of this method of prediction depends upon a continuity of policy on the part of an administration able to increase both its case work staff and the load carried in fairly quick response to the natural rise in need. Another practical limitation is the necessity of good judgment in drawing the free-hand projections of the seasonal fluctuations within the limits of the standard error of estimate and the direction of the upward climb of the cycle.

The theoretical limitations are typified by the question, what should be done when the business cycle turns? It can not go downward forever; what will you do when you hit the bottom and how will you be able to anticipate the time of the true rise of the cycle? The only answer that can be made at present is this. Assuming a continued lag and lead relationship of 6 months, there will be at least this period of leeway for experimental adjustment and trial and error. If a longer lag is found, it will simplify the problem. If a shorter lag is found, it will make procedure more difficult. Furthermore, apart from the technical lag relationship there is the fact that dependency and relief, because of their cumulative nature, tend to persist [1] long after the gross causal factors that occasioned them have ceased to operate in acute form. Perhaps all that can be said at this stage is that the authors are working at this problem which is as yet only in its theoretical stage.

To a considerable extent a satisfactory answer to this interesting theoretical problem is bound up with the problem of discovering the real meaning of the parameters in the square parabola of the trend, $Y = 100 - 3.5\ X + 0.264\ X^2$. Analogical reasoning from the meaning of the parameters in the parabola of the trajectory of a projectile, suggests that the a-term describes the normal number of relief cases of normal times. It consists of chronic paupers, and persons whose employment

[1] See Jessie A. Bloodworth, *Social Consequences of Prolonged Unemployment*, University of Minnesota Employment Stabilization Research Institute, Vol. 2, No. 5., August, 1933; also Ewan Clague and Webster Powell, *Ten Thousand Out of Work*, University of Pennsylvania Press, 1933, especially part 2 by Webster Powell.

is so irregular and whose management of their lives is so ineffectual that the slightest reverse, misfortune, or change of season, throws them upon relief. The cx^2 term represents the tendency of the number of relief cases to pile up if there were no checking factors. The $-bx$ term supplies the checking factor which sometimes keeps the family going for a period of months or years before it is finally driven to seek relief. This checking factor may include a variety of resources such as good management, use of savings, use of credit, borrowing on life insurance, and aid from friends and relatives. However adequate or inadequate these observations may be in supplying the framework for theoretical work, it is evident that they apply only to the secular trend. Theoretical treatment of the seasonal fluctuations that are superimposed upon the cycle, must give consideration to such seasonal factors as decrease of employment during the winter months and the increase of fuel orders. One represents an important economic influence culminating in the winter. The other is the reflection of weather changes on the family budget. Taken together the two factors synchronize with the seasonal increase in relief and seem an important partial explanation of the acuteness of the seasonal rise and fall of relief. The whole problem of causal relationships is complicated but unusually interesting in this field of research.

MEASURES OF THE INEQUALITY IN THE PERSONAL DISTRIBUTION OF WEALTH OR INCOME[1]

By Dwight B. Yntema

In order to measure and so to compare the commonly recognized phenomenon of inequality in personal distribution which exists at different times and in different places, coefficients of inequality[2] are employed. Such coefficients may be formulated with the object either (1) of measuring the degree of unequalness among the individual shares of the distributed attribute—wealth or income—or (2) of measuring the degree of unequalness in the distribution of a resulting character which is functionally associated with the attribute. In the case of income distribution, Hugh Dalton prefers the latter course, since primary interest concerns distribution of welfare rather than distribution of income, as such.[3] This procedure encounters the difficulty of finding the function which relates the individual's welfare to his income as well as the necessity of assuming identity between different individuals. Benham calls the resort to subjective considerations non-scientific.[4] The present discussion, however, is concerned with the first of the two alternatives, being limited to coefficients devised to measure inequality in the distribution of the attribute itself. By so doing, the problem of measuring inequality in the distribution of wealth is made formally the same as that of measuring inequality in distribution of income.

Certain *a priori* limitations may be imposed on coefficients of inequality. An acceptable coefficient must be both independent of the number of persons in a distribution, and independent of the unit in which income, or wealth, is measured.[5] And, in contrast with pro-

[1] The writer acknowledges gratefully the grant of a Sterling fellowship at Yale University, 1930–1931, which provided an opportunity to concentrate on the problem of measuring inequality. Additional attention was given this subject at the University of Michigan. The present discussion represents one phase of the work.

[2] A distinction between "inequality" and "concentration" has been made by Allyn A. Young, "Do the Statistics of the Concentration of Wealth in the United States Mean What They Are Assumed to Mean?"; this Journal, 1917, pp. 470 ff. Concentration means "undue or excessive" inequality.

[3] Hugh Dalton, *Inequality of Incomes*, 2nd impression, London, 1925, appendix, pp. 1–2. The appendix is a reprint of "The Measurement of the Inequality of Incomes," *Economic Journal*, Vol. 30, 1920.

[4] F. C. Benham, "Economic Welfare," *Economica*, 1930, p. 176. Distribution of national income, Benham considers one of several "objective indicia" of a community's prosperity (p. 177); compare his book, *The Prosperity of Australia*, London, 1930, pp. 10 ff.

[5] Cf. F. R. Macaulay, "The Personal Distribution of Income in the United States," part III in *Income in the United States*, II, National Bureau of Economic Research, New York, 1922, p. 375. The writer asserts that a proportional increase in the income of every recipient does not change inequality. Corrado Gini, "Il diverso accrescimento delle classi sociali," *Giornale degli Economisti*, 2 series, 38, 1909, p. 69; Hugh Dalton, *loc. cit.* pp. 9–11. Dalton concludes that proportional additions to all incomes decrease inequality but acquiesces to independence of the unit of measure.

cedures which require successive comparisons, either numerical or graphic, between corresponding elements of two or more distributions,[1] a true coefficient must characterize each distribution by a single definitive value which will lead to an unambiguous conclusion when the extent of inequality between different distributions is being compared. For selecting the preferable coefficients from the many that satisfy these principles, the following discretionary criteria may be proposed. The numerical value of a coefficient should not be difficult to compute. A coefficient should be more or less adaptable to the peculiarities and limitations of existing data; the footnotes of Tables I and II refer to distributions which are considered representative for the purposes of this discussion. A coefficient of inequality should admit of interpretation which is in harmony with the connotation implied in the word, inequality, however vague the connotation be.[2] Finally, coefficients having definite finite limits, 0 and 1 preferably,[3] are desirable since such limits aid in attaching significance to the numerical value of a coefficient for any particular distribution.

Below are outlined eight plausible measures [4] of the inequality in personal distribution. Each satisfies the limiting conditions stated above and is in keeping with the discretionary criteria. It may be noted that the mode, median, harmonic mean and the quartiles do not appear in the formulation of the eight coefficients; the frequency distributions employed subsequently in an empirical appraisal of the coefficients are not complete enough to permit a suitable determination of these values.

Let N represent total frequency; let Ma represent the arithmetic mean of the attribute magnitudes; and let S represent the standard attribute, i.e., the square root of the average square of the attribute magnitudes. The first six coefficients are measures of dispersion;[5] for these, the name is abbreviated in forming the symbol.

[1] For examples: A. L. Bowley, *The Measurement of Social Phenomenon*, London, 1915, pp. 210–213; L. R. Connor, "Income in the United Kingdom, 1913–1924," *Journal Royal Statistical Society*, Vol. 91, 1928, pp. 60–61, 73; W. I. King, *The National Income and Its Purchasing Power*, New York, 1930, pp. 172–179; W. I. King, *The Wealth and Income of the People of the United States*, New York, 1922, pp. 72, 79, 81, 85, etc.

[2] Cf. A. C. Pigou, *The Economics of Welfare*, London, 1924, p. 84. W. M. Persons, "The Variability of the Distribution of Wealth and Income," *Quarterly Journal of Economics*, Vol. 34, 1909, pp. 431, 433, 438; Hugh Dalton, *loc. cit.*, sections 4, 7, 9.

[3] Cf. Umberto Ricci, *L'indice di variabilità e la curva dei redditi*, Roma, 1916, p. 2.

[4] Cf. L. von Bortkiewicz, "Die Disparitätsmasse der Einkommensstatistik," and the following observations and notes by C. Gini, F. Savorgnan, and G. Pietra in *Bulletin de l'Institut International de Statistique*, Tome 25, 3e livraison, 1931, pp. 189–320M. The controversy regarding "la paternité des idées" (p. 320H) has brought out pertinent references with considerable detail.

Coefficients 5 and 6, defined in terms of logarithms, have been added to the more common measures of dispersion. The list is not presumed to be exhaustive.

[5] The number of possible coefficients of dispersion is unlimited. For the deviation formulas, any of the several central positions can be used; the absolute values of the deviations from the selected central position can be raised to any desired power in the definition of a measure of dispersion. Reduction to relative terms may be accomplished through division by any of the central positions. Analogously, a

(1) $M.D\ (Ma)$ = relative mean deviation referred to Ma; the mean deviation from Ma divided by Ma.[1]

(2) $M.Df\ (Ma)$ = relative mean difference, with repetitions,[2] referred to Ma; the sum of the absolute values of differences between each attribute pair divided by $\frac{N^2}{2} \cdot Ma$.

The relative mean difference, without repetitions, is double Gini's Ratio of Concentration, R.[3]

(3) $V(Ma)$ = coefficient of variation referred to Ma; the standard deviation divided by Ma, i.e., $\frac{\sigma}{Ma}$.

The square root of the average (with repetitions) square of the differences between each attribute pair divided by Ma equals $\sqrt{2} \cdot V(Ma)$.[4]

(4) $V(S)$ = coefficient of variation referred to S; the standard deviation divided by S, i.e., $\frac{\sigma}{S}$.

Again, the square root of the average (with repetitions) square of the differences divided by S equals $\sqrt{2} \cdot V(S)$.[4]

(5) $M.D_{(\log)}$ = mean deviation using logarithms of attribute values, deviations taken from the arithmetic mean of the logarithms.[5]

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difference coefficient can be formulated by the use of any power, with reduction to relative terms through division by any central position. Cf. Corrado Gini, *Variabilità e mutabilità*, Bologna, 1912, pp. 10, 96, etc. Umberto Ricci, *op. cit.*, p. 60.

[1] Umberto Ricci, *op. cit.*, chap. IV. Ricci defines an Index of Variability, I, as equal to one-half the relative mean deviation.

[2] Corrado Gini, *op. cit.*, p. 21. The mean difference with repetitions, Δ_R, is related to the mean difference without repetitions, Δ, as follows: $\Delta_R = \frac{N-1}{N} \cdot \Delta$.

For the relative mean difference, with repetitions, the following holds: $M.Df\ (Ma) = \frac{\Delta_R}{Ma} = \frac{N-1}{N} \cdot \frac{\Delta}{Ma}$.

[3] Corrado Gini, "Sulla misura della concentrazione e della variabilità dei carattere," *Atti del Reale Istituto Veneto di scienze, lettere ed arti*, Tomo 73, part 2, 1913–1914, pp. 1207 ff. $\frac{\Delta}{Ma} = 2R$.

[4] Cf. Corrado Gini, *Variabilità e mutabilità*, pp. 37, 96, etc. L. von Bortkiewicz, *op. cit.*, pp. 207–210; and "Observations," C. Gini, p. 300.

[5] These two coefficients of dispersion are made independent of the unit of measure by the logarithmic treatment itself. Cf. G. U. Yule, "Review of Irving Fisher's 'The Making of Index Numbers,'" *Journal Royal Statistical Society*, Vol. 86, 1923. "As it appears to me, the standard deviation of logarithms is analogous not to the arithmetic standard deviation but to the coefficient of variation" (p. 420).

Comparable to the measures of logarithmic dispersion is R. Gibrat's coefficient of inequality, C (*Les inégalités économiques*, Paris, 1931, p. 80). Since Gibrat concludes that the "law of proportional effect" applies to personal distribution data, he favors the use of the following formula in fitting a line to the data (p. 94):

$$y = \frac{1}{\sqrt{\pi}} e^{-z^2} \quad \text{where } z = a \log (x - x_0) + b.$$

(6) $\sigma_{(\log)}$ = standard deviation using logarithms of attribute values.[2]

(7) α = Pareto's coefficient of inequality; the absolute value of the slope[1] of the line which is obtained by plotting on double log paper the number of persons (ordinate) having income, or wealth, at least as large as a given value (abscissa).[2]

(8) δ = Gini's Index of Concentration; the slope[1] of the line which is obtained by plotting on double log paper the number of persons (ordinate) with an attribute greater than a given amount as a function of the total attribute (abscissa) held by these.[3]

Each of the eight coefficients may be said to measure the departure in distribution of income, or wealth, from a condition of absolute uniformity; yet, in doing so, each emphasizes a different aspect of the inequality phenomenon and effects measurement in a different manner. The dispersion coefficients may be contrasted with α and δ in that the latter are slopes of linear functional relationships between the number of persons and the attribute.[4] Further, α and δ have been employed to indicate the extent of inequality when distribution for the rich alone is available; in fact, the function from which α is derived is not suited to serve as an approximation to distribution among more than the richer element.[5]

The dispersion coefficients may be divided into two classes as to whether they require averaging deviations from a central position or

x_0 is a constant whose introduction shifts the origin of the x values. The coefficient of inequality is defined: $C = \frac{100}{a}$. If taking logarithms of $(x-x_0)$ renders the distribution normal, it follows that

$$a \log(x-x_0)+b = \frac{\log(x-x_0)-M_{\log(x-x_0)}}{\sqrt{2}\cdot\sigma_{\log(x-x_0)}}.$$

Then, $a = \frac{1}{\sqrt{2}\cdot\sigma_{\log(x-x_0)}}$ and, consequently, $C = 100\sqrt{2}\,\sigma_{\log(x-x_0)}$. In case $x_0 = 0$; C becomes a multiple of $\sigma_{(\log)}$ defined in (6).

[1] The procedure employed in determining the values of α and δ in the following pages may be found in F. Savorgnan, "Di alcuni metodi per misurare la distribuzione dei redditi in Austria (1903–1910)," *Bulletin de l'Institut International de Statistique*, Tome 25, 3e livraison, 1931, pp. 333–336. An alternative procedure is explained, pp. 338–340. C. Gini, in *Indici di Concentrazione*, pp. 16–20, gives the same procedures and advises against the method of least squares in fitting a straight line.

[2] Vilfredo Pareto, *Cours d'economie politique*, Lausanne, 1897, Bk. II, part 1, chap. 1; and *Manuel d'economie politique*, Paris, 1909, pp. 390–391. For distributions of wealth, Pareto proposes a modification to his function by adding a constant, *a*, to the attribute, wealth (*Cours*, p. 310, note). In the following pages the unmodified function is used for both wealth and income distributions. Cf. R. Gibrat, *op. cit.*, pp. 111–115.

[3] Corrado Gini, "Il diverso accrescimento . . .," *loc. cit.*, pp. 70–83 (first statement); and *Indici di Concentrazione*, pp. 16 ff. (a more elaborate presentation). Regarding wealth data, refer to the latter, pp. 73–76.

[4] Corrado Gini, "Observations," *Bulletin de l'Institut International de Statistique*, *op. cit.*, p. 300.

[5] F. R. Macaulay, *op. cit.*, pp. 340 ff.

whether an average difference between each attribute pair is found. Of the two, averaging differences has been preferred by Gini.[1] This procedure assures freedom from the arbitrary choice of a central position from which deviations are computed. When second powers are taken, as in the two cases noted above, the distinction between the deviation and the difference coefficients is not of great importance since the difference coefficients prove to be multiples of corresponding deviation coefficients. The presence of the arithmetic mean in the formulas may be defended on grounds that it represents the attribute magnitude that would obtain under equal distribution. An evaluation of the weight that the larger deviations or differences have in contributing to the degree of inequality is implied in the dispersion coefficients. $V(Ma)$ and $V(S)$, being defined in terms of squares of deviations, accord the larger values greater weight than do $M.D(Ma)$ and $M.Df(Ma)$. By introducing logarithms, as is the case with $M.D_{(\log)}$ and $\sigma_{(\log)}$, the relative weight of the larger deviations is much reduced.

Graphic interpretations for the relative mean deviation and the relative mean difference have been devised. Let p_k represent the per cent of the total number of persons that those individuals constitute who have attribute less than a given amount x. Let q_k represent the per cent of total attribute held by the individuals who have less than the amount x. As x increases, p_k and q_k vary from 0 to 100. A graph of the successive points (p_k, q_k) in the rectangular coordinate field gives the so-called Lorenz curve.[2] In this plot, the line of equal distribution is the straight line drawn from (0, 0) to (100, 100). With an increase in inequality, the Lorenz curve bends farther from the line of equal distribution. The y-intercept of a tangent to the Lorenz curve drawn parallel to the line of equal distribution, taken positively and divided by 100, since percentage figures are used, equals one half the relative mean deviation.[3] When the area between the Lorenz curve and the line of equal distribution is divided by the corresponding area that represents complete inequality, the quotient is half the relative mean difference.[4] This ratio, Gini has called R, the Ratio of Concentration. If the coordinates of the successive points are determined for data in frequency distribution form, and a broken line, not a curve, is drawn through the points, the area between the broken line and the line of equal distribution expressed as a decimal of the maximum area

[1] Corrado Gini, *Variabilità e mutabilità*, pp. 17–20; and "Note," *Bulletin de l'Institut International de Statistique*, *op. cit.*, p. 320, footnote.

[2] M. O. Lorenz, "Methods for Measuring Concentration of Wealth," this JOURNAL, Vol. 9, 1905, pp. 209–219. Cf. C. Gini, "Observations," *op. cit.*, pp. 305–309, and "Note," p. 320G.

[3] G. Pietra, "Observations," *Bulletin de l'Institut International de Statistique*, Tome 25, 3^e livraison, 1931, p. 310, also "Note," p. 320M.

[4] Footnote 3, p. 425. Cf. C. Gini, "Note," *loc. cit.*, p. 320G.

gives R'. To compute R' with the aid of a calculating machine the following formula is of service:

$$R' = \tfrac{1}{2}\Sigma(p_{k-1}\cdot q_k - p_k\cdot q_{k-1})\cdot\frac{1}{5{,}000}.$$

In effect, the formula sums areas of the triangles, any one of which is determined by the origin and two successive observational points.[1] In Tables I, II, and III, R' replaces $M.Df\ (Ma)$.

The following summary of the eight coefficients indicates the aspect of inequality that each measures. The lower and upper[2] limits are given; as inequality increases, the values of a coefficient will diverge from the lower limit.

SUMMARY OF EIGHT COEFFICIENTS OF INEQUALITY SHOWING ASPECT MEASURED AND LIMITS

Coefficient	Symbol	Aspect of inequality measured	Lower limit (equality)	Upper limit (maximum inequality *)
(1) Relative mean deviation, referred to *Ma*	$M.D\ (Ma)$	Deviations from *Ma*, or distance in Lorenz plot	0	$\frac{2(N-1)}{N}$
(2) Relative mean difference, referred to *Ma*	$M.Df\ (Ma)$	Differences between attribute pairs, or area in Lorenz plot	0	$\frac{2(N-1)}{N}$
(3) Coefficient of variation, referred to *Ma*	$V\ (Ma)$	Squares of deviations from *Ma*	0	$\sqrt{N-1}$
(4) Coefficient of variation, referred to *S*	$V\ (S)$	Squares of deviations from *Ma*	0	$\sqrt{\frac{N-1}{N}}$
(5) Mean deviation of logarithms	$M.D_{(log)}$	Deviations of logs from *Ma* of logs	0	$\frac{2(N-1)}{N}\cdot Ma_{(log)}$
(6) Standard deviation of logarithms	$\sigma_{(log)}$	Deviations of logs from *Ma* of logs	0	$\sqrt{N-1}\cdot Ma_{(log)}$
(7) Pareto's coefficient of inequality	α	Slope of line on double log paper	∞**	0**
(8) Gini's index of concentration	δ	Slope of line on double log paper	1	∞

* For coefficients 1 to 4 and 7 and 8, the assumption is made that all attribute is concentrated in the hands of one individual. For coefficients 5 and 6, the assumption is made that all individuals, save one, have a unit of attribute; the rich individual holds the remaining attribute.

** Pareto has stated (*Cours, loc. cit.*, p. 312) that a decrease in the value of α points to less inequality. He is corrected in various places, as in, F. Savorgnan, "Di alcuni metodi . . .," *loc. cit.*, p. 332, note; Allyn A. Young, *loc. cit.*, p. 477; Corrado Gini, *Indici di concentrazione*, p. 40.

In measuring the extent of inequality in given distributions, Dalton has concluded provisionally that it is better "not to rely upon the evidence of a single measure, but on the corroboration of several," adding that in most practical cases the five coefficients he recommends

[1] Other formulas are found in B. DeFinetti e U. Paciello, "Calcolo della differenza media," *Metron*, Vol. 8, 1930, pp. 89–94.

[2] Cf. C. Gini, "Sul massimo degli indici di variabilità," *Metron*, Vol. 8, 1930, pp. 3 ff.

"will give results pointing in the same direction, but in some cases they may not do so." [1] With the purpose of analyzing the nature of this suggested corroboration, ten wealth distributions and seven income distributions have been selected for study. It is assumed the ten wealth distributions are comparable in that each exhibits the presence of the same phenomenon, namely, inequality in personal distribution of wealth—this, despite disparity in definition of wealth and person having wealth. A similar assumption is made for the income distributions. The values of the eight coefficients have been computed for the wealth distributions (Table I). Below each coefficient's value appears

TABLE I

COMPUTED VALUES OF EIGHT COEFFICIENTS OF INEQUALITY FOR SELECTED WEALTH DISTRIBUTIONS,* WITH RANKS OF THE DISTRIBUTIONS AS DETERMINED BY EACH COEFFICIENT **

	$M.D$ (Ma)	R'	V (Ma)	V (S)	$M.D$ (log)	σ (log)	α	δ
I—Assets males Australia, '15	1.42 5	800 6	6.58 5	.089 5.5	.670 10	.767 10	1.36 2	2.72 4
II—Assets females Australia, '15	1.33 2	.820 2	5.17 2	.085 1.5	.610 8	.680 8	1.54 1	2.33 1
III—Wealth U.S., '20	1.09 1	.605 1	5.63 3	.080 3	.340 1	.455 1	1.23 4	3.23 7
IV—Estates France, '09	1.43 6	.800 6	14 8 9	.098 9.5	.600 9	.732 9	1.21 5.5	3.12 6
V—Estates U. K., '07–'11	1 64 10	.906 10	17 1 10	.098 9.5	.381 3	.540 4	1.20 3	2.90 5
VI—Estates men Mass., '59–'61	1 41 3.5	820 3	6.66 6	.089 5.5	.303 2	.540 2	1.12 7	2.70 3
VII—Estates men Mass., '79–'81	1 55 8	.876 8	8.77 7	.093 7	.403 4	.542 3	1.03 10	3.31 9
VIII—Estates men Mass., '89–'91	1.47 7	.860 6	6 22 4	.088 4	.401 6	.604 7	1.00 8	2.60 2
IX—Estates men Wis., 1900	1.41 3.5	.843 4	5 50 1	.085 1.5	.502 7	.600 6	1.04 9	3.25 8
X—Estates U.S., '12–'23	1.60 9	.893 9	14.5 8	.098 – 8	.400 5	.575 5	1.21 5.5	3.55 10

* Data from the following sources:
I and II, G. H. Knibbs, *The Private Wealth of Australia and Its Growth*, Melbourne, 1918, pp. 30–31;
III, W. I. King, "Wealth Distribution in Continental United States," this JOURNAL, Vol. 22, 1927, p. 152;
IV–IX, W. I. King, *The Wealth and Income of the People of the United States*, pp. 87, 89, 68, 68, 69, 70, respectively;
X, Federal Trade Commission, *National Wealth and Income*, 69th Congress, 1st Session, Senate Document No. 126, 1926, p. 58.

** *The computed values of Gibrat's coefficient of inequality, C*, are 128, 115, 120, 141, 155, 146, 150, 148, 122, and 144 with ranks 4, 1, 2, 5, 9, 7, 10, 8, 3, and 6 respectively for distributions I to X.

the rank that is assigned to the distribution when the numerical values found for the ten distributions by any one coefficient are ranked according to the degree of inequality. The distribution exhibiting the

[1] Hugh Dalton, *op. cit.*, p. 10.

least inequality is ranked 1, the distribution exhibiting next to the least inequality 2, etc. Obviously, if there were perfect agreement among the coefficients in adjudging the extent of inequality, the rank assigned to any one distribution would be identical for all the coefficients.[1] A similar table with values of the coefficients and their ranks has been prepared for the income distributions, Table II.

TABLE II

COMPUTED VALUES OF EIGHT COEFFICIENTS OF INEQUALITY FOR SELECTED INCOME DISTRIBUTIONS *, WITH RANKS OF THE DISTRIBUTIONS AS DETERMINED BY EACH COEFFICIENT **

	M.D (Ma)	*R'*	*V (Ma)*	*V (S)*	*M.D* (q_1)	$\sigma(q_1)$	α	δ
I—Income, males Australia, '15	.602 5	.436 6	2.05 2	.890 2	.275 6	.309 6	1.88 2	2.29 2
II—Income, females Australia, '15	1.010 7	.605 7	2.88 3	.945 3	.386 7	.438 7	1.67 5	2.27 1
III—Income, adults Australia, '20	.464 1	.294 1	1.00 1	.707 1	.064 1	.108 1	1.55 6	2.57 4
IV—Income, gain. emp., U. S., '18	.553 3	.382 4	3.68 5	.964 5	.172 5	.271 5	1.80 3	2.48 3
V—Income, U. S. Families, '10	.530 2	.364 2	7.32 7	.992 7	.160 4	.226 3	1.90 1	2.74 5
VI—Income Prussia, '10	.631 6	.404 5	3.17 4	.940 4	.154 3	.237 4	1.53 7	2.97 6
VII—Income U. K., '10–'20	.587 4	.373 3	4.09 6	.978 6	.143 2	.208 2	1.78 4	3.03 7

* Data from the following sources:
I and II, G. H. Knibbs, *op. cit.*, p. 24;
III, Jas. T. Sutcliffe, *The National Dividend*, Melbourne, 1926, p. 45;
IV, National Bureau of Economic Research, *Income in the United States, I*, New York, 1921, p. 136;
V and VI, W. I. King, *The Wealth and Income of the People of the United States*, pp. 233, 225, respectively;
VII, Josiah Wedgwood, *The Economics of Inheritance*, London, 1929, p. 42.
** The computed values of Gibrat's coefficient of inequality, *C*, are 114, 110, 104, 145, 128, 130, and 143 with ranks 2, 3, 1, 7, 4, 5, and 6 respectively for distributions I to VII.

In determining the values of the coefficients for Tables I and II, no corrections were made for discontinuity in data brought about by frequency distribution classification.[2] But the effect of classification on the ranking of any particular coefficient's values was reduced by using distributions which had a comparable number of classes. This required summarizing the more extensive tables (in doing so, classes showing negative attribute were combined with the lowest positive attribute class—Wealth Distributions I and II). The number of classes of the wealth distributions varied from 12 to 15. Income distributions VI and VII had 8 and 10 classes respectively; the remaining income distributions 13 or 14. Only the richer classes were used in computing the values of α and δ. For wealth data, those richer

[1] For greater detail, ranks may be replaced by reduced values.
[2] Note the corrections Bortkiewicz develops for the relative mean deviation (*op. cit.*, pp. 210–217).

persons who held about 50 per cent of the total attribute were taken; for income data, approximately 20 per cent of the richest people were used in each instance.

From Tables I and II it appears that the expected corroboration among the several coefficients in adjudging the extent of inequality has failed to materialize, since there is little uniformity in the ranking of any one wealth distribution or any one income distribution. If the coefficients α and δ are ignored in Table II, the dispersion coefficients remaining agree in giving first rank to distribution III. But, in ranking the six other income distributions, the dispersion coefficients contradict each other. However, consistency is found in certain sub-groups of the coefficients. $M.D(Ma)$ and R' constitute a consistently acting sub-group, as do $V(Ma)$ and $V(S)$, and $M.D_{(\log)}$ and $\sigma_{(\log)}$. An explanation of the similarity in the rankings of each sub-group of coefficients can be found in the fact that the coefficients comprising a sub-group measure and define inequality in much the same manner. This may be indicated as follows:

$M.D(Ma)$ and R' [or $M.Df(Ma)$]	first powers of deviations or differences; line or area in Lorenz diagram
$V(Ma)$ and $V(S)$	second power of deviations
$M.D_{(\log)}$ and $\sigma_{(\log)}$	deviations of logarithms from arithmetic mean of logarithms

Between α, δ, and the three groups of dispersion coefficients, there is little evidence of consistent uniformity.[1]

Account must be taken of a coefficient's adaptability to available wealth and income data. For Tables I and II, frequency distributions of 8 to 15 classes have been employed; much of the personal distribution materials do not allow this degree of completeness,[2] although in isolated instances more detailed tables are available. An indication of the extent to which the eight coefficients' values are affected by frequency distribution classification of serial data may be seen in Table III. The values of the coefficients for a serial array of the incomes of 100 persons [3]

[1] The computed values of C, Gibrat's coefficient of inequality (Tables I and II, footnotes) give results dissimilar to those obtained from the logarithmic measures of dispersion. This would be expected since the latter are defined without resort to the additional parameter x_0 (footnote 2, p. 425) the introduction of which tends to make C, as a measure of inequality, rely on the particular distribution among richer persons alone, rather than on the distribution among all persons. Nor does it appear that C and any of the other coefficients appraise the extent of inequality similarly.

[2] M. A. Copeland, "How large is our National Income?" *Journal Political Economy*, Vol. 40, 1932, p. 701.

[3] The distribution was synthesized in an impromptu manner from the 1924 figures in *Recent Economic Changes* (M. A. Copeland, "National Income and Its Distribution," chap. 12, p. 836, New York, 1929) supplemented by the general shape of the Lorenz curve of the 1918 data of the National Bureau (*Income in the United States*, I, p. 136). Note that the data deal with distribution of income among "dependent population" and gainfully employed, respectively.

appear in row (1). After the serial data had been thrown in typical frequency distribution form (typical, in that there are 14 income classes, 37 per cent of the total frequency in the lowest income class, and decreasing percentages in each successive class) the values of the coefficients were computed again, row (2). Row (3) shows the change in each coefficient brought about by the classification. In row (5) this change is expressed in terms of the effective range of variation found from Table II by subtracting the smallest value from the greatest value, taking one coefficient at a time. Table III indicates that

TABLE III

VALUES OF EIGHT COEFFICIENTS OF INEQUALITY FOR FICTITIOUS INCOME DATA IN SERIAL ARRAY AND IN TYPICAL FREQUENCY DISTRIBUTION

	$M.D(Ma)$	R'	$V(Ma)$	$V(S)$	$M.D_{(\log)}$	$\sigma_{(\log)}$	α	δ
(1) Serial array	.550	.398	1.26	.782	.229	.317	1.67	1.96
(2) Frequency distribution	.548	.384	1.25	.782	.208	.295	2.13	1.99
(3) Difference, i.e. ‖(1)-(2)‖	.002	.014	0.01	.000	.021	.022	0.46	0.03
(4) Range of variation (Table II)	.550	.311	0.32	.285	.322	.240	.46	.75
(5) Difference ÷ Range, i.e. (3)/(4)	.00(4)*	.05	[illegible]	.00	.07	.09	1.00**	.04

* The arithmetic mean is found nearly midway in a class interval, making the difference large rather than small

** This change is brought about by two influences:

a—When the total frequency is small, the lower class limit of the classified data may vary considerably without altering the frequency of a given class. In the change from serial data, this tends to increase the value of α.

b—For the distribution in question, the values of α_i (see procedure for computing, note 1, p. 426) for the less rich are smaller than for the richest. In finding α for the frequency distribution, fewer of the smaller values of α_i enter into the average which gives α.

with data such as used in this study there is some reason [1] to prefer $M.D(Ma)$, $V(Ma)$, and $V(S)$ to δ and R', which in turn may be preferred to $M.D_{(\log)}$ and $\sigma_{(\log)}$. α is subject to suspicion. In so far as data are available in greater or less detail than has been assumed herein, these tentative findings require modification.

The necessity of selecting a particular coefficient of inequality in place of relying on several coefficients is occasioned by the failure to find agreement between coefficients which are differently constituted. The choice is largely determined by two factors: (1) the completeness of available data, and (2) the tacit assumption that inequality consists in that aspect of personal distribution which a given coefficient measures. Gini and Savorgnan recommend the relative mean dif-

[1] If a coefficient understates the extent of inequality consistently for different frequency distributions, the relative positions of the distributions are scarcely altered by the understatement.

ference and δ.[1] They have emphasized the advantages of δ over α.[2] Gini feels that the relative mean difference will be used widely because of its general applicability.[3] If data permit, Dalton would employ the relative standard deviation, i.e., $V(Ma)$, and the relative mean difference. The fact that $V(Ma)$ has an upper limit of $\sqrt{N-1}$ while a limit such as unity is desirable suggests the substitution of $V(S)$ for $V(Ma)$. $V(S)$, however, shows an actual range of variation for the ten wealth distributions of only 13 points in the third decimal place; perhaps, an alternative formulation, $\frac{S-Ma}{S}$, may prove more suitable than either $V(Ma)$ or $V(S)$; the range of variation for the wealth distributions then becomes 119. On the grounds that the large attribute values should be accorded little weight, $M.D_{(\log)}$ and $\sigma_{(\log)}$ may find justification. However, the selected frequency distributions are none too complete for this logarithmic treatment.

[1] Corrado Gini, "Observations," *loc. cit.*, p. 200; F. Savorgnan, "Observations," *loc. cit.*, p. 307.

[2] As in: Corrado Gini, *Indici di concentrazione*, *op. cit.*, pp. 48-49; F. Savorgnan, "Di alcuni metodi per misurare . . .," *loc. cit.*, pp. 332-333. Bortkiewicz asserts that α is not suited to serve as a measure of inequality (*loc. cit.*, p. 222).

[3] Corrado Gini, "Observations," *loc. cit.*, p. 200.

NOTES

A TEST FOR SIGNIFICANCE IN A UNIQUE SAMPLE

By A. E. Brandt, *Iowa State College*

If $d_1, d_2, d_3, \ldots, d_n$ are the differences between n observations on the response of two organisms to the same treatment or on the effect of two treatments on the same organism, and if these differences represent all of the available data, Fisher's t-test [1] may be used to test whether the mean of the differences is significantly different from zero.

Frequently, however, quantitative data are lacking, that is, the differences are recorded as plus, minus or zero, or, though quantitative data are given, an easily computed approximation will suffice. In such cases the accompanying chart may be used conveniently and with a small amount of calculation. It is based on the binomial, $(p+q)^n$, and the familiar test for the significance of a mean difference, the ratio of the mean difference to its standard deviation.

In using this approximate method, the differences are taken so that the plus ones shall be in excess. The variables have been designated as follows:

p_o = observed proportion of plus differences.
p = expected proportion of plus differences.
q $=1-p$.
n = number of differences observed.
N_1 = number of differences for highly significant (1 per cent) point.
N_5 = number of differences for significant (5 per cent) point.
σ $=\sqrt{Npq}$.

Of these, only p_o must be calculated. The formula is

$$p_o = \frac{\text{number of plus differences plus half the number of zeros}}{\text{total number of differences}}$$

If the two organisms are expected to react alike or if the two treatments are expected to have the same result, $p=q=.5$. Under these conditions

$$\begin{aligned}\sigma &= \sqrt{N(.5)(.5)}\\ &= .5\sqrt{N}.\end{aligned}$$

The difference between the observed number of successes and the expected number is

$$Np_o - N(.5) = N(p_o - .5).$$

[1] R. A. Fisher, *Statistical Methods for Research Workers*, 4th edition, Oliver and Boyd, London, 1932.

The ratio of this difference to its standard deviation is

$$\frac{N(p_o-.5)}{.5\sqrt{N}}=x$$

which reduces to

$$\sqrt{N}(p_o-.5)=.5x.$$

In Table 1 of Fisher (1932), the value of x for the highly significant (1 per cent) point is 2.576, and for the significant (5 per cent) point it is 1.960. These values substituted in the above equation give for the 1 per cent point

$$\sqrt{N_1}\ (p_o-.5)=1.288$$

or, taking logarithms of both sides,

$$.5 \log N_1+log\ (p_o-.5)=0.1099 \qquad (1)$$

and for the 5 per cent point

$$\sqrt{N_5}\ (p_o-.5)=0.980$$

or

$$.5 \log N_5+\log\ (p_o-.5)=-0.0088. \qquad (2)$$

The accompanying chart, then, is simply an alignment chart based on equations (1) and (2). The logarithms of $(p_o-.5)$ for values of p_o from 0.55 to 1.00 are plotted on the first line but the values of p_o instead of $(p_o-.5)$ are shown. The logarithms of the square roots of N_1 and N_5 are plotted on the second and third lines respectively, recording the values of N_1 and N_5 instead of their square roots. If a straight edge is placed on any value of p_o at a right angle to the three parallel lines, the corresponding values of N_1 and N_5 can be read at its intersection with the second and third lines.

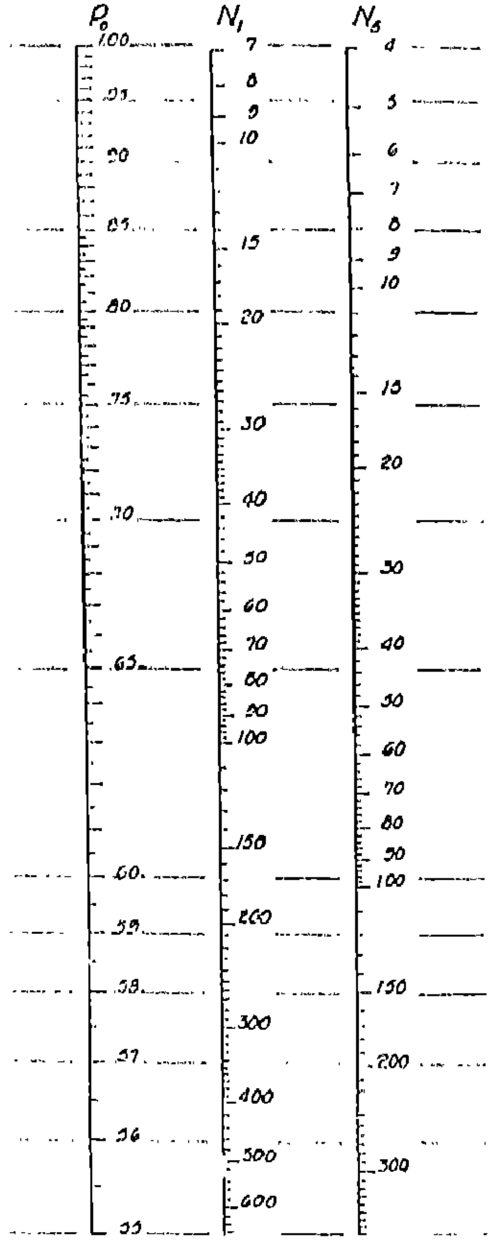
The Criterion of Significance: If n is equal to N_1 there is but one chance in a hundred that as great a proportion of success as that observed could have been secured on the basis of chance alone, that is, the difference is highly significant. If n is equal to N_5, there are not more than 5 chances in a hundred that as great a proportion of successes as that observed could have been secured on the basis of chance alone, or the difference is significant.

Examples:

(a) In 648 coöperative yield tests of Kanred and Turkey winter wheats made in Kansas,[1] Kanred outyielded Turkey 429 times and

[1] S. C. Salmon, *The Point Binomial Formula for Evaluating Agronomic Experiments*, 22: 77–81, 1930.

NUMBER OF OBSERVATIONS NECESSARY FOR A SIGNIFICANT (N_5) OR HIGHLY SIGNIFICANT (N_1) MEAN DIFFERENCE FOR VARIOUS VALUES OF P_0



there were 6 ties. To test the significance of the difference in yielding power of these two wheats by means of the chart, proceed as follows:

$$n = 648$$

$$p_o = \frac{429 + (6)(.5)}{648}$$

$$= 0.6667.$$

The value of N_1 corresponding to $p_o = 0.6667$ on the chart is 36. Since 648 is greater than 36 (n greater than N_1) there is less than one chance in a hundred that Kanred could have outyielded Turkey in the observed proportion of cases on the basis of chance alone. In other words, the difference is highly significant.

(b) Fisher (1932) quotes, from Student's paper, Cushny and Peebles' data on the difference in sleep producing quality of the optical isomers of hyoscyamine hydrobromide. Ten patients were used and the effect was measured in hours of sleep gained by the use of each isomer. Nine of the ten patients gained more hours of sleep from the use of the levo- than from the dextro- and the tenth case was a tie. In this case

$$n = 10$$

$$p_o = \frac{9 + .5}{10}$$

$$= 0.95.$$

The value of N_1 corresponding to $p_o = 0.95$ on the chart is 8. Since 10 is greater than 8 (n greater than N_1) the difference in effect of the two isomers is highly significant. This conclusion agrees with that of Fisher which he based on the actual values of the differences instead of on their signs only.

Charts can easily be constructed for other expected proportions of successes. In genetics, especially, observed phenotypic ratios could be compared very readily with such theoretical ratios as 3 to 1, 9 to 7, 15 to 1 and others after suitable charts had been prepared.

THE CENTRAL STATISTICAL BOARD

On July 27, 1933, by executive order of President Roosevelt a Central Statistical Board was established "to appraise and advise upon all schedules of all government agencies engaged in the primary collection of statistics required in carrying out the purposes of the National Industrial Recovery Act, to review plans for tabulation and classification of such statistics, and to promote the coordination and improvement of the statistical services involved."

The members of the Board are:

Winfield W. Riefler, *Chairman*, and Economic Adviser to the Executive Council.

Oscar E. Kiessling, *pro tem*, Chief Economist of the Mineral Statistics Division, Bureau of Mines.

Mordecai Ezekiel, Economic Adviser to the Secretary of Agriculture (Louis H. Bean, Economic Adviser to the Agricultural Adjustment Administration, alternate).

John Dickinson, Assistant Secretary of Commerce (William L. Austin, Director of the Bureau of the Census, alternate).

Isador Lubin, Commissioner of Labor Statistics.

E. A. Goldenweiser, Director of Research and Statistics, Federal Reserve Board.

Alexander Sachs, Chief of Division of Economic Research and Planning, National Recovery Administration.

Meredith B. Givens, Executive Secretary of the Committee on Government Statistics and Information Services.

E. Dana Durand, Chief Economist, Tariff Commission.

Corrington Gill, Director of Research and Statistics, Federal Emergency Relief Administration.

Stuart A. Rice, Assistant Director, Bureau of the Census.

W. R. Stark, Chief of Section of Financial and Economic Research of the Treasury Department.

O. C. Stine, Chief of Division of Statistical and Historical Research, Bureau of Agricultural Economics.

Although the work of the Board is limited to statistics bearing on recovery, the Board may be regarded as the successor of the recently dissolved Federal Statistics Board, which itself succeeded the war-time Central Statistical Bureau. Like the Federal Statistics Board, the new Board has advisory powers only. It will not itself engage in the collection, compilation, or analysis of data. It will, however, have a small staff to make investigations as a basis of the Board's recommendations, headed by the Board's Executive Secretary, Morris A. Copeland.

The scope of the activities of the Board is reflected in the Committees of the Board of which there are eleven to date, as follows: Nominations; Common Interests of the Census, National Recovery Administration, and the Bureau of Labor Statistics; Reporting of Statistics Under Codes of Fair Competition; Construction Statistics; Review of Schedules and Tabulation Proposals; Maintenance of Statistical Services; Unemployment Statistics; Central Tabulation; Retail Price Statistics; Budget and Procedure; Mortgage Statistics.

The Office of the Board is at Room 7028 in the Commerce Building.

COMMITTEE ON GOVERNMENT STATISTICS

The Committee on Government Statistics and Information Services, appointments to which for the quarter ending September 30 were made jointly by the President of the Association and the Executive Director of the Social Science Research Council, has been reconstituted for the autumn quarter of 1933. Willard L. Thorp and Stuart A. Rice, members during the summer quarter, have accepted appointments to government positions, the former as Director of the Bureau of Foreign and Domestic Commerce and the latter as Assistant Director of the Census. They have, therefore, not been continued as Committee members.

The reconstituted Committee, subject to possible further appointments, consists of Edmund E. Day, *Chairman*, Meredith B. Givens, *Executive Secretary*, Donald Belcher, John D. Black, Robert E. Chaddock, Morris A. Copeland, W. L. Crum and Bryce M. Stewart. The members of the Washington staff of the Committee now include: Viva Boothe, Ewan Clague, John H. Cover, Morris A. Copeland, Edward R. Gray, Meredith B. Givens, William M. Hoad, Joseph B. Hubbard, Murray W. Latimer, Jacob Perlman, George W. Stocking, Tracy E. Thompson, Sydney W. Wilcox, and Helen Wright. Mr. Clague has been added to the Advisory Committee to the Secretary of Labor, which is affiliated with the Committee on Government Statistics. M. R. Benedict of the Giannini Foundation of the University of California will join the staff on October 2, to represent the Committee in the field of agricultural statistics.

In addition to the above, others who have served the Committee for limited periods of time include the following: Frederick J. Dewhurst, Constant Southworth, Margaret Clem, Edna Lonigan, Hilding Anderson, Woodlief Thomas, Warren Thompson. The Committee now has the advantage of the active advice and counsel of its chairman, Dr. Edmund E. Day, who has recently returned from abroad.

The Committee on Government Statistics is represented on the Central Statistical Board by Meredith B. Givens. The services of Morris A. Copeland have been loaned by the Committee to the Board to enable him to serve the latter as its Executive Secretary. A full report of the work of the Committee during the first two quarters of its activity will be presented at the annual meeting of the Statistical Association at Philadelphia in December.

A substantial fraction of the Committee's task has been concerned with the work of the affiliated Advisory Committee to the Secretary of Labor, of which Bryce M. Stewart is Chairman. Several members of the resident staff are members of this Committee, and have given full time service to problems within its special field. In addition, invaluable service has been rendered by non-staff members of the Advisory Committee, including Miss Aryness Joy, Mr. Howard B. Myers, and Mr. Ralph G. Hurlin. (Written September 15, 1933.)

THE NATIONAL RECOVERY ACT AND RETAIL PRICES

A dinner meeting of the American Statistical Association was held on Tuesday evening, October 10, 1933, at the Roger Smith Restaurant on 41st Street near Madison Avenue, New York City. One hundred and seventeen persons were present. Dr. W. W. Cumberland of Wellington and Company, presided. The general topic for discussion was The National Recovery Act and Retail Prices.

The first speaker of the evening was Dr. Oswald Knauth, Treasurer of R. H. Macy and Company. He began by discussing the price fixing rules which are being proposed for insertion in a number of the codes governing the retail industries. It is proposed, for example, to prohibit retailers from selling articles below a figure representing cost plus a certain percentage of cost. It is also proposed to forbid the sale of standard trade-marked goods at a price more than 21 per cent below that figure set by the manufacturer of the article as the standard retail price. The avowed intent of these restrictions is to prevent "predatory price cutting." Unfortunately, it does not seem possible to determine just when price cutting becomes "predatory." The fact is that one merchant can sell goods at a rate lower than another merchant and still not lose money in the process, provided his costs of doing business are lower. Merchants do, indeed, often sell goods below cost. Obviously, this procedure cannot be carried far without bankrupting the merchant who employs it. As a matter of fact, such below-cost sales are usually small in volume and are resorted to only for purposes of attracting customers into the store. This is merely a form of advertising which, if indulged in to a limited extent, may be profitable, and is as legitimate as any other means of attracting trade. The logic of attempting to eliminate this practice is, then, decidedly open to question.

If a serious attempt is made to enforce the provision requiring that all goods be sold at cost plus a certain profit percentage, many difficulties are sure to be encountered. Retail business operates on the principle of an average mark-up for a whole class of merchandise. The merchant does not know how much it costs him to handle any particular article. Furthermore, the number of different articles carried is usually so large as to make it impracticable to estimate the cost involved in handling any single item. If the merchant himself does not know the real cost of an article, how can it be determined by the regulative authorities?

It is to be remembered, also, that bankrupt stocks of merchandise are often purchased at prices far below the cost of reproducing the articles. How is the regulator to know what the merchant paid for each article? If the enforcing officials are required to study intensively the cost of each of the hundreds of thousands of separate articles carried by the various merchants, how long will it take to cover all the mercantile establishments in the United States?

Another fact to be kept in mind in connection with the proposal to fix re-sale prices of trade-marked articles is that the Supreme Court of the United States might not be sympathetic to such action. Decisions of the courts up to the present time have tended to the view that manufacturers have no legal right to

fix the retail prices on their products unless they themselves do the retailing. Even if merchants are effectively prevented from selling trade-marked articles *below the prices set by the manufacturers, how will it be possible to prevent* merchants from evading the law by utilizing such devices as giving special privileges, rebates, or premiums? If the law were actually enforced, would not the chief net result be to cause the merchants to deal in non-trade-marked articles which could be sold to the public at prices lower than those which it would be necessary to charge for the trade-marked varieties?

One point that should never be lost sight of is that the consumer must ultimately pay any added costs which result from regulations of the type just mentioned. Wage earners are consumers as well as producers. In their function as consumers, they will suffer from higher prices just as much as do other classes of buyers.

It must be remembered also that any regulation which increases the cost of doing business and hence raises the prices of articles offered for sale almost inevitably results in a curtailment in the purchases of these articles. If fewer articles are sold, production of these articles will decline, and this reduction in the volume of output will add to the amount of unemployment.

At the close of Dr. Knauth's address, Dr. Cumberland took occasion to state that business men usually agree that the whole theory of price fixing is normally unsound from the economic standpoint. Even so, most of these same business men urge that the Government intervene to keep up the prices of the particular articles which they themselves have for sale.

The second regular speaker of the evening was Mr. Edward L. Bernays, Public Relations Counsel. He spoke on the subject, "The Moulding of Public Opinion." Mr. Bernays pointed out that the National Recovery Act has been designed to bring about a common understanding between labor, the employers, and the consumers. In order to persuade all branches of industry and all of the interests in these industries to coöperate fully, the Government has found it necessary to engage in an active campaign of propaganda. At the same time, most of the groups interested have coupled with the Government propaganda a large amount of propaganda designed to gain support for their own special interests.

Forecasters, in making their calculations, usually consider it unnecessary to consider propaganda. If, however, they are to attain success in their prophecies, they will do well to take cognizance of the propaganda work which is being done. For example, after a serious train wreck, the manufacturers of steel cars may start a campaign to abolish wooden cars. If this campaign is successful, the whole car manufacturing industry may be greatly affected. In recent years, advertising has carried the public first to one food and then to another. These resulting changes in the eating habits of the people have affected greatly the welfare of certain classes of the farm population, for if people eat more of one food they will eat less of another and one set of producers gains at the expense of the other.

The successful propagandist must take advantage of the basic impulses and prejudices of the population or else he will meet with little success. Since individuals generally look for leadership to the outstanding men in the social groups

with which they happen to be affiliated, propaganda, to be successful, must receive endorsement from these key men. Furthermore, the successful propagandist usually knows how to employ effectively catchy phrases of one kind or another. For example, one of the things which apparently has given great advantage to the "wets" in recent years has been that their propagandists have succeeded in coupling in the public mind the word "racketeer" with the word "prohibition." At present, there are many types of media which are used to influence public opinion. Among such types may be mentioned the following: newspapers, books, billboards, telegrams, radios, churches, Chautauquas, women's clubs, Lion's clubs, Rotary clubs, and motion pictures.

In introducing the next speaker, Dr. Cumberland called attention to the fact that Mr. Zelomek, at a meeting in 1932, had forecast the movement of retail prices during the coming year. At that time, there were many who doubted greatly the accuracy of Mr. Zelomek's forecasts. His accuracy is probably ascribable not to mere luck but primarily to his careful analysis of the facts at hand.

Mr. Zelomek began his address by remarking that, in his opinion, most statisticians, in predicting the future, qualify their statements with so many "ifs" and "buts" that it is impossible to tell what they mean. He promised to be specific. In carrying out this program he began by stating that, although retail prices have already risen materially, they are destined to go much higher. The probabilities are, however, that the advance during the next six months will be at a rate less than the advance during the last six months. Nevertheless, by April 15, 1934, prices of men's clothing will be at least one-third higher than at present, and retail prices in general, as indicated by the Fairchild index, will stand approximately 50 per cent above their 1932 low. The chances are that, by next autumn, retail prices will be higher than they were in 1923.

Retail prices are destined to advance because of the fact that they are arrived at by marking up wholesale prices, and wholesale prices have already advanced much more than retail prices. Furthermore, the Administration is tied up to a policy of pushing up the prices of raw materials. If this is done, it will necessarily mean that retail prices will go still higher. For a long time now, prices of finished products have been too low to enable industries to operate on a profitable basis while the existing level of costs is maintained. The consumer has been profiting at the expense of the employer, and also at the expense of the producer of raw materials.

At present, there is a widespread belief that retail prices will not go up because it is assumed that retailers are now overstocked with goods purchased because of the threat of inflation. The truth is, however, that such overpurchasing is almost entirely mythical. Most retailers have been unable to increase their stocks, for, to do so, requires additional credit, and, for many months now, it has been impossible for the average merchant to secure additional credit.

Mr. Zelomek concluded by pointing out that the movements of retail prices are of great consequence to those members of the population who depend upon fixed incomes. Every rise in retail prices is injurious to this class of the population.

At the close of Mr. Zelomek's remarks, the Chairman expressed regret that Mr. Zelomek had failed to call attention to the fact that higher prices would mean a smaller volume of sales and that this reduction in volume of trade might affect the public very adversely.

The last regular speaker of the evening was Mr. Paul T. Cherington, Distribution Consultant. He began by commenting upon the mythical belief, now widely held, that advertising dominates the consumers to such an extent that they no longer have any freedom of choice in their purchases. He stated that those concerns which spend millions of dollars upon advertising wish heartily that this belief corresponded to the facts. The truth is that advertisers are often painfully ignorant as to what the results of their advertising will be. In many instances, the consumers fail to follow in the manner expected, the lead given. This fact was recently impressed forcefully upon a manufacturer of tooth paste who had persuaded many retail druggists to set up elaborate window displays advertising his product. Investigation proved that these window displays did result in increased sales of the tooth paste in question, but that most of the increase occurred in the cut-rate drug stores, while the regular priced drug stores gained practically nothing by putting the displays in their windows. Buyers are still inclined to follow the wise practice of not mixing charity with business —hence they buy where the goods may be obtained cheapest.

Of course, the public is interested not only in the price but also in the type of goods offered. In this connection, style plays as important a part as quality. The retailer wins who is more successful than his competitors in guessing what the public is going to want. Many merchants guess badly and are soon out of business.

In answer to an inquiry, Dr. Knauth pointed out that the manufacturer as well as the retailer must cater to the whims of the public. Production and merchandising must both be looked upon as reflections of these whims.

Mr. Bernays pointed out that the present campaign to "Buy Now" is sound only in so far as it is predicated on the assumption that prices will be higher in the near future.

Mr. Zelomek said that the public have already been subjected to so many "Buy Now" campaigns that they have become extremely skeptical of all predictions that prices are going higher. Furthermore, the grim fact remains that people cannot buy if they do not have the money. The poorer classes can, therefore, buy more only if their incomes are increased by fuller employment or higher wages.

Several of the speakers who followed emphasized the fact that purchasing of goods has fallen off during recent years, not because consumers have been unwilling to buy, but because their incomes have been seriously impaired both by unemployment and by losses incurred through investments or speculation. Only the limited number of consumers who have had unimpaired incomes have profited by the low prices which have prevailed. The great shortage of buying has been mainly in the realm of production goods and raw materials—purchases of consumers goods having held up fairly well.

One speaker emphasized the fact that the proposed code provision forbidding

sales on a margin of less than ten per cent profit will affect but a very small proportion of retail business, for most sales are made at much higher margins. Another speaker held that the whole aim of the National Recovery Act program is to keep all present retailers in business. It would be far better for the public if the inefficient retailers were driven out of the field.

In response to a question from the Chairman, Willford King pointed out that, if the present campaign to raise wages is followed by an increase in retail prices, the labor unions will promptly demand that wages be raised still higher. If this is done, employers will be unable to continue in business unless they can sell their products at higher prices. The only way to keep up wage rates and yet secure higher prices for the products will be to inflate the currency. If inflation brings higher retail prices, there will then be a demand for higher wages, and so on indefinitely. Such demands in other countries have often led to a program of inflation which has ruined all classes. While the elevation of prices to the level prevailing between 1922 and 1929 is highly desirable, such a procedure should be undertaken upon a purely scientific basis and under the most rigid control.

The fixing of individual wages and individual prices in a competitive field has been attempted at many times and places, but has almost never produced the results expected by the authorities responsible for the price fixing. In most cases, the outcome has been highly unsatisfactory.

The whole idea of attempting to regulate the details of the entrepreneur's business is repugnant to American ideals of individual freedom. To carry out such a policy effectively means that one-half of the nation must be trained to spy upon the other half. Is this the vocation which we desire to cultivate?

The discussion was closed by Dr. Charles G. Smith. He called attention to the fact that price fixing, while new in the thoroughly competitive field, has long been in vogue in those branches of industry dominated by monopolies or "affected with a public interest," as for example, railroads, public utilities, and insurance companies. In these fields, the regulating officials have been subject to much pressure and many difficulties have arisen. For example, the public has always clamored for lower rates, regardless of the cost of doing business. Nevertheless, regulation has, in many respects, worked satisfactorily.

WILLFORD I. KING, *Secretary*

PROGRESS OF WORK IN THE CENSUS BUREAU

THE PRINTING SITUATION

Without drawing upon the Bureau's limited printing allotment for the current year, sufficient funds have now been procured to complete the printing of the remaining eight volumes of the Fifteenth Census Reports referred to in the September issue of the JOURNAL. The editions will be limited to 1,000 copies each. There will remain, however, a number of studies based on the Fifteenth Census which are completed in manuscript ready to go to the printer and for which no funds are available and none in prospect.

The estimated cost of the printing which in regular course ought to be done

in the current fiscal year, 1933–34, was $86,000. The total amount allotted to this Bureau was only $45,000. After deducting the cost of job work and of printing the necessary schedules, the amount remaining for the printing of the reports is only about $21,000, or hardly more than one-third the amount allocated to that purpose under the original estimates.

In order to meet this serious situation radical reductions had to be made in the printing program, as shown by the following statement:

Reports	Funds for printing as allocated under:	
	Original estimates	Amount actually allotted
Annual Report of the Director	$125.00	$55.00
Mortality Statistics: 1930 (annual)	*4,989.84	4,580.00
Birth Statistics: 1930 (annual)	*9,327.18	9,127.18
Financial Statistics of States: 1931 (annual)	*291.43	291.43
Financial Statistics of Cities: 1931 (annual)	*10,503.02	....
Financial Statistics of State and Local Governments, 1931 (decennial):		
State Bulletins	*5,780.70	....
Digest of State Laws, 1932 (state bulletins)	3,059.71	....
Census of Manufactures: 1931 (biennial)	*13,004.07	770.03†
Clay and Refractory Products (annual)	271.09	....
Paper and Paperboard (annual)	100.00	....
Lumber, Lath, and Shingles (annual)	325.00	....
Electrical Industries, 1932 (quinquennial):		
Electric Railways	2,047.18	
Central Electric Light and Power	980.38	3,000.00†
Telephones	700.53	
Telegraphs	230.14	
Animal and Vegetable Fats and Oils (annual)	402.44	110.22
Cotton Production in the United States (annual)	980.00	473.28
Cotton Production and *Distribution* (annual)	1,885.74	....
Defective, Dependent, and Delinquent Classes, 1931 (decennial):		
Prisoners	1,408.53	1,468.53
Mental Patients in State Hospitals	1,450.55	1,531.47
Feeble-minded and Epileptics	682.00	
Total—publications	$59,600.11	$21,434.14

* Balance remaining after paying first charges.

† Provides for printing only 10 industry reports and a summary for all industries, in addition to the 11 which were printed in the previous fiscal year. *The original estimate provided for printing 66 reports* (in addition to the 11 already printed) of which 25 were in proof and the remaining 41 in manuscript ready to go to the printer prior to July 1, 1933.

In view of this situation the Census Advisory Committee, at the meeting held in Washington on September 22 and 23, adopted the following resolution:

> The Census Advisory Committee is greatly concerned to learn that owing to the fact that the funds allotted for printing are about 50 per cent below the amount asked for and estimated as necessary, the Bureau has been compelled to abandon or postpone indefinitely the printing of some of the reports which will be completed ready for publication in the current fiscal year and to curtail very materially the scope and detail of others. It is obvious that in so far as the statistics which the Bureau compiles and tabulates can not be printed, the money expended on their collection is wasted. Either the Bureau should be provided with funds sufficient to print the results of the statistical compilations which it is authorized or directed by law to make, or else the scope of such compilations should be reduced to come within the limits imposed by the funds that will be available for printing the results.
>
> The Committee therefore recommends that steps be taken to secure, if possible, supplementary funds for printing the current reports; and looking to the future that an organized effort be made to do away with the present practice of making a separate appropriation for printing as applied to the work of the

Census Bureau and include the cost of printing in the appropriation granted directly to the Bureau for carrying on the statistical inquiries which it may be authorized or directed by law to make.

CENSUS OF MANUFACTURES

In making plans for the biennial census of manufactures covering the year 1933, the Bureau is confronted by the fact that there is very little money available for field work, so that unless funds can be provided sufficient for that purpose the census will have to be taken largely by mail. The data for the biennial census are regularly obtained by use of one general and a large number of special schedules, the latter covering the same inquiries as the general schedule with respect to total value of products, number of wage-earners, cost of materials, etc., but specialized for each industry with regard to details of products, materials, and machinery, peculiar to that industry. At the 1933 Census it is proposed to limit the use of the general schedule and the special industry schedules to that group of the larger establishments in each industry which contributed, at the census for 1931, approximately 90 per cent of the total value of products of the industry. The remaining establishments are to be canvassed by means of a short-form schedule which will call for only certain basic data. This short-form schedule will go to between 60 and 70 per cent of the establishments covered by the census, although the proportion receiving it will not be the same in all industries. This method of making the canvass will not greatly reduce the proportion of products for which detailed statistics can be given, but will reduce materially the work of tabulating the data and, for the smaller establishments, will lighten the burden of preparing their returns.

It is proposed that the period covered by the census shall in all cases be the calendar year, which for the great majority of manufacturing establishments is the business or fiscal year. Where that is not the case, the Bureau has heretofore accepted the business or fiscal year ending at any date prior to March 31. This has resulted in a delay of three months in receiving the reports from certain firms. It is believed that it will not be very difficult for these firms to supply the desired information for the calendar year, thus expediting the publication of the results of the census.

Looking to the future, it is proposed to do away with the biennial census of manufactures and in place thereof have an annual census of limited scope and a complete and comprehensive quinquennial census. This will require enabling legislation, which the Bureau hopes to obtain. The quinquennial census would seem to belong in the year 1934, this being the year midway between the decennial censuses of 1929 and 1939, but it may be decided to shift the decennial year for the census from 1939 to 1938, accept the 1933 biennial census as the equivalent of a quinquennial census, begin the annual censuses with 1934, and have the first complete quinquennial census to cover the year 1938. With these possibilities in mind it is proposed to begin a revision of the special industry schedules with a view to adapting them for the purposes of an annual census for 1934.

CENSUS OF WEALTH, DEBT, AND TAXATION

As stated in the June issue of the JOURNAL, the Bureau of the Census began publishing the results of the decennial compilation of financial statistics of state and local governments, formerly known as the census of wealth, debt, and taxation, in a series of state bulletins or reports under the title "Financial Statistics of State and Local Government, 1931." Only three of these state reports have now been printed. Twenty-four more are completed in manuscript ready for printing and the others will probably be ready before February 1. But owing to the deficiency referred to in the allotment for printing, the publication of these reports has been suspended with little prospect of its being resumed before the next fiscal year, which begins July 1, 1934.

REGISTRATION AREA COMPLETED

The admission of the state of Texas to the birth and death registration area means that for the first time the registration of deaths and births in the United States is complete, covering every state and the District of Columbia, and that the Director of the Census who is charged with the responsibility of compiling statistics of births and deaths will now be able for the first time to announce a death rate or birth rate for the United States without resorting to estimates for states not within the area. It means also that the machinery has been set up and is in successful operation for registering every death and every birth in the United States as it occurs, recording the disease, accident, or violence that caused the death, also the age, sex, nativity, conjugal condition and occupation of the decedent; or in case of a birth, the sex of the child, and the age, color, nativity, and occupation of the father and of the mother, the total number of children born to the mother, and other data, thereby furnishing the basis for the collection of complete vital statistics covering the entire country. To bring about this result has taken more than thirty years of organized and persistent effort on the part of the Bureau of the Census assisted by the American Public Health Association, the National Tuberculosis Association, and a special committee representing the principal insurance companies.

DIVISION OF STATISTICAL RESEARCH

The Bureau has recently established a Division of Statistical Research to have charge of the preparation of monographs, make studies of technical problems arising in connection with the regular work of the Bureau, consider plans for improving the form of statistical presentation in the Census Reports and undertake similar tasks. This division has been placed in charge of Joseph A. Hill as Chief Statistician. For the time being, and until the Bureau has more ample funds, the work of this division will be limited to what can be accomplished by the Chief Statistician and two or three assistants.

WORK FOR OTHERS

The work of the Bureau of the Census is being extended in various directions beyond the statistical inquiries which it regularly conducts and for which it is responsible. It is making numerous statistical tabulations for the N.R.A., and

also for trade associations, using funds provided by these organizations for that purpose; it is tabulating the results of the cost-of-living inquiry conducted by the Bureau of Labor Statistics in the District of Columbia; and through its Cotton Field Service it is collecting certain statistical data for the Agricultural Adjustment Administration. A recent order by the Secretary of Commerce directs the centralization of all tabulating activities falling within the Department of Commerce in the Bureau of the Census.

J. A. H.

MISCELLANEOUS NOTES

Calendar Reform Committee.—The Committee on Calendar Reform of the American Statistical Association held an emergency meeting at N.R.A. headquarters in Washington September 20, 1933. The committee convened at the suggestion of Dr. Stuart A. Rice, President of the Association and a member of the Central Statistical Board, the newly created coördinating body for the Government's permanent and emergency statistical agencies with relation to the recovery program. The emergency arose in connection with the problem of determining a uniform reporting period for employment, pay-roll, man-hour, production and other data from industries under the Codes.

The Committee unanimously adopted the following recommendation which was formally presented to the Central Statistical Board on September 13, 1933, by the Committee chairman, Mr. M. B. Folsom:

"It is recommended that the current statistics of industry and trade relating to employment, pay-roll, production, and other data used as a measure of the volume of business activity should be reported for periods of one week, two weeks or four weeks, with the object of making possible comparisons on a four week basis; it being understood that in the case of certain industries, or fields of activity exceptions to this practice may be appropriate."

The Calendar Reform Committee is composed of the following, all of whom attended the meeting:

Chairman, M. B. Folsom, Assistant Treasurer, Eastman Kodak Company, Rochester, New York.

Dr. C. F. Marvin, *Chief of the Weather Bureau, Department of Agriculture*, Washington, D. C.

Dr. S. L. Andrew, Chief Statistician, American Telephone & Telegraph Company, New York City.

Professor H. S. Carter, University of Pennsylvania, Philadelphia, Pennsylvania.

Professor A. H. Hedrich, Department of Bio-Statistics, The Johns Hopkins University, Baltimore, Maryland.

Dr. Julius Parmelee, Director, Bureau of Railway Economics, Washington, D. C.

Dr. W. J. Donald, formerly managing director of The American Management Association, now Executive Vice-President, Packaging Machinery Manufacturers Institute, 52 Wall Street, New York City.

R. P. Towne, Assistant Treasurer, National Blank Book Company, Holyoke, Massachusetts.

Dr. E. Dana Durand, Chief Economist, Federal Tariff Commission, Washington, D. C.

Meredith N. Stiles, *Secretary*, Rochester, New York.

Present at the meeting, in addition to members of the Committee, were Stuart A. Rice, J. B. Hubbard, and Viva Boothe of the Committee on Government Statistics, Andrew T. Court, of the National Recovery Administration, and A. H. Robinson, Statistician of the Eastman Kodak Company.

The Committee also discussed the broader phases of calendar reform and a subcommittee was named to draft an inclusive report for discussion at subsequent meetings.

The secretary of the Committee is remaining in Washington to consult representatives of trade groups with respect to the application of the Committee's recommendations to their industries.

Business Statistics Section of the Cleveland Chapter.—The first fall meeting was held at the Chamber of Commerce Club on Monday, September 25. Officers for the coming year were elected. Mr. K. H. MacKenzie of the Cleveland Federal Reserve Bank was elected Secretary, Mr. E. A. Stephen of The Ohio Bell Telephone Company as Chairman. Following the election of officers, the Group made its semi-annual forecast of the Annalist Index of Business Activity. Each forecaster explained the reasons for his projection. Meetings on the last Monday of every month are planned for the season.

The Los Angeles Chapter.—A summer dinner meeting was held in conjunction with the Southern California Economic Association on July 10, 1933. The speakers of the evening were Dr. Thomas Nixon Carver of Harvard University and Dr. George W. Dowrie of Stanford University, who spoke on "Current Economic Trends."

The Philadelphia Chapter.—On January 13 a dinner was given by the Philadelphia Statistics Group in honor of Dr. Stuart A. Rice on the occasion of his election to the Presidency of the American Statistical Association. Dr. Rice talked to the Group about his work with the President's Committee on Social Trends.

At this meeting the Group voted to reorganize as the Philadelphia Chapter of the American Statistical Association, a Committee being appointed to prepare plans for an organization meeting.

The Chapter organization meeting followed on March 31. At this meeting Dr. S. S. Kuznets of the National Bureau of Economic Research and the University of Pennsylvania discussed "Problems of Measuring the National Income."

The officers of the new Chapter are: President, W. J. Carson, Assistant Professor of Finance; Vice-President, Ewan Clague, Research Director, Community Council of Philadelphia; Secretary-Treasurer, H. S. Davis, Industrial Research Department, University of Pennsylvania.

Members of Executive Committee: J. Parker Bursk, Assistant Professor of Statistics, University of Pennsylvania; Casimir A. Sienkiewicz, Statistician, Philadelphia Federal Reserve Bank.

The first meeting of the Philadelphia Chapter following its organization in March was held on May 26. At this meeting Dr. O. E. Baker, Senior Agricultural Economist with the Department of Agriculture, Washington, discussed the subject, "Prospects for the Consumption of Farm Products."

The Pittsburgh Chapter.—Luncheon meetings have been held at the Harvard-Yale-Princeton Club, Pittsburgh, on July 27, August 24, and September 28. The subject of the first was "The National Recovery Program and its Probable Influence on Business." Papers were presented by E. C. Stone, W. R. Bingham, T. H. Gerken and J. D. Beatty. Mr. Stone, Assistant to the President of the Philadelphia Com-

pany and President of the Pittsburgh Chapter, discussed the fiscal phases of the efforts being made to bring about recovery, concluding that sustained recovery cannot be produced for the last of 1933 and the first of 1934. Mr. Bingham of the Bell Telephone Company in his discussion of the Agricultural Adjustment Administration anticipated that materially augmented farmer buying power will help considerably toward recovery. Mr. Gerken of *Iron Age* presented the theoretical advantage of extensive reëmployment, yet felt industrial inertia would so slow down recovery as to force further inflationary steps. Mr. Beatty of the Carnegie Institute of Technology from labor and consumer standpoints described the retardation of public works programs and foresaw another critical winter of unemployment with much labor difficulty and extreme need for public relief.

On August 24, Mr. C. B. Metzger, Superintendent of the Edward A. Woods Company, spoke on "Three Years of Performance." He explained that as a distributor and conservator of wealth the life insurance institution has performed a stupendous function with the result that life insurance has come to be regarded as a property investment and savings available as security for any emergency requiring cash. Life insurance companies have rendered many services over the past three years. They have increased employment; they have been an aid to city and country banks; and they have disbursed money through policy loans and cash surrender values.

The meeting on September 28 was addressed by Mr. L. Brandt, a Housing Engineer of Pittsburgh, who spoke on "Plan for the Development of Garden Homes Under Subsistence Homestead Division, U. S. Department of the Interior, as Provided for in the National Recovery Act." He discussed the movement in theory, showed the steps that have already been taken, and forecast some of the probable results.

United States Bureau of Labor Statistics.—For several months the Bureau has been devoting a great deal of its time to preparing material needed by the National Recovery Administration. In this connection, a field survey of labor in the shirt industry was conducted jointly, in June, 1933, by the Bureau of Labor Statistics, the Children's Bureau, the Women's Bureau, and the Conciliation Service of the United States Department of Labor. The study covered approximately 20,000 workers in 129 establishments in 9 of the principal shirt-manufacturing states. The results of the inquiry were published in the *Monthly Labor Review* for September, 1933.

An investigation of the cost of living of government employees in the District of Columbia was begun in September by the Bureau of Labor Statistics in coöperation with the Bureau of Home Economics of the United States Department of Agriculture. The investigation is being made for the purpose of securing data to be used in the adjustment of the wages of Federal employees.

The Bureau will report monthly, in the *Labor Review*, statistics of employment created as a result of expenditures by the Public Works Administration, showing the total number of workers employed, the man-hours worked, and the amount of pay rolls. In addition, the tabulations will show expenditures for materials purchased and the amount of employment created indirectly in the fabrication of these materials. The first report will present data for the period September 15 to October 15, 1933.

The labor provisions of the industrial codes adopted under the National Industrial Recovery Act are being summarized by the Bureau and published in the *Labor Review*.

Surveys of wages and hours of labor are being conducted for air transportation and for motor-bus and truck transportation. During recent months there have been published in the *Labor Review* data from the Bureau's latest studies of wages and

hours in bituminous coal mining, in the iron and steel industry, and in the glass industry, and of union scales of wages and hours of labor and entrance wage rates of common labor.

In August the Bureau began collecting figures on retail prices biweekly instead of monthly as heretofore. Press releases summarizing the data are issued as soon as the figures can be tabulated, while full details are published in printed pamphlets. The Bureau also issues weekly and monthly wholesale price indexes.

Because of the great public interest in provisions for the care of the aged, information on the experience under state old-age pension laws has been gathered by the Bureau for several years. The experience for 1932 was covered in the August, 1933, *Labor Review*. An article in the October *Review* summarizes the recent state legislation on old-age pensions and compares the provisions of all existing state laws on this subject.

Other topics which have been the subject of special study by the Bureau, and of articles in the *Labor Review*, during recent months have included the accident experience in the iron and steel industry to the end of 1932; building operations during the first half of 1933; the credit-union movement in the United States in 1932; development of the coöperative movement throughout the world; and work of state labor offices in behalf of wage claimants.

Appointments to the Bureau of Foreign and Domestic Commerce.—On August 1, Dr. Willard L. Thorp of Amherst, Massachusetts, was appointed by the President as Director of the Bureau of Foreign and Domestic Commerce. He obtained his A.B. degree in 1920 from Amherst College, his M.A. degree from the University of Michigan in 1921, and his Ph.D. from Columbia University in 1924. In 1921 he was employed by the Census Bureau in the preparation of a special monograph entitled *The Integration of Industrial Operation;* from 1925 to 1926 he was Director of Research for the New York Board of Housing. He has been Professor of Economics at Amherst since 1926. He is the author of *Business Annals* and *Economic Institutions;* as well as a frequent contributor to magazines on various economic subjects.

Announcement has also been made of the appointment of Nathanael H. Engle, a former employee of the Census Bureau, to the position of Assistant Director of the Bureau of Foreign and Domestic Commerce. Mr. Engle served as expert in marketing with the wholesale census of distribution from April, 1930, to December, 1932. He has been on the staff of Brookings Institution since last December. Mr. Engle is a graduate of the University of Washington and holds the Ph.D. from the University of Michigan. He is author of a score or more of articles and monographs on business and economic subjects, including several bulletins prepared as a part of the Fifteenth Census.

United States Department of Agriculture.—Funds for the maintenance of the market news service of the Bureau, which had been entirely cut off and then partially restored, were on August 17 still further increased by order of the Secretary of Agriculture. The reduction in market news funds now stands at about 25 per cent.

Dr. Frederick V. Waugh, formerly Executive Secretary of the New England Research Council, on July 1 joined the staff of the Division of Statistical and Historical Research. In coöperation with the Consumers Council of the Agricultural Adjustment Administration, he is engaged in research to determine the relation between consumption and the prices consumers have to pay, and the factors affecting the consumption of agricultural products.

Reduced appropriations have necessitated certain curtailments in the Foreign Agri-

cultural Service of the Department of Agriculture. The offices at Pretoria, South Africa, and Sydney, Australia, have been closed and the officers in charge of these posts have been recalled to the United States. From each of the posts at Belgrade, Yugoslavia; Marseilles, France; and Buenos Aires, Argentina, where formerly two representatives of the Department have been stationed, one officer has been recalled. Clerical and operating expenses in the Berlin, London and Shanghai offices have been reduced. The vacancy in the former position of commodity specialist on tobacco in Europe has not been filled, but the commodity specialist in China on cotton and the commodity specialists in Europe on fruits, on grain, and on meats and wool continue to function as formerly.

In response to Senate Resolutions 280 and 281 respectively, there have been prepared in the Bureau of Agricultural Economics reports issued as Senate Document No. 70, "*World Trade Barriers in Relation to American Agriculture*," and Senate Document No. 181, "Economic Situation of Hog Producers." The former pertains to restrictions upon international trade in major agricultural products throughout the world, measures undertaken in several countries to protect the position of their farm producers, and the effects of these restrictions and measures upon prices of farm products and the welfare of American farmers. The latter pertains to the hog situation and the probable effects of the proposed export debenture, equalization fee, and domestic allotment plans for farm relief, on the economic position of hog producers.

A booklet by L. H. Bean and A. P. Chew, entitled "Economic Trends Affecting Agriculture," consists of statistical charts and tables, accompanied by brief explanatory notes. The contents of the booklet (which is intended primarily for agricultural extension workers) are grouped under three main headings: "The Relation of the Industrial Depression to Agriculture," "World Influences on American Agriculture," and "Disparities in Incomes and Prices." The introduction to the booklet says: "Farmers could get along formerly with comparatively few economic facts . . . Things are different now . . . Economic information useful to farmers no longer means information relating exclusively or even mainly to farming. It touches practically every phase of our complex and highly integrated economic system."

Market Reviews and Statistical Summaries of Livestock, Meats and Wool is the name of a new publication issued weekly by the Bureau of Agricultural Economics. Compiled and edited by the Livestock, Meats and Wool Division, it is designed to carry in convenient form the more important economic statistics pertaining to the livestock, meats, and wool industries as they become available. Current weekly, monthly, and yearly livestock price and supply data will be carried, as well as brief interpretative articles and special discussions dealing with economic conditions and developments in these industries.

Children's Bureau, United States Department of Labor.—The *Monthly Bulletin on Social Statistics*, now being published by the Children's Bureau, combines in a single publication the current reports on relief and other welfare services formerly presented separately in the *Monthly Relief Bulletin* (issued since January, 1932) and the *News Bulletin on Social Statistics in Child Welfare and Related Fields* (issued since July, 1932). The current statistics on relief are reported to the Children's Bureau by approximately 1,000 agencies in 120 cities and city areas and show expenditures from public and private funds and the number of families aided. Separate reports on meals and lodgings provided to homeless and transient persons are reported monthly by 180 agencies in 58 cities. The social statistics project covers 21 subjects in child welfare and related fields and includes a total of approximately 2,200 agencies in 43 of these cities.

The relief and social statistics constitute one of three major series of statistics now assembled and reported regularly by the Children's Bureau, the other two being juvenile employment statistics, based upon reports from officials in an increasing number of states and cities, in charge of issuance of employment certificates to working children, and juvenile court statistics relating to juvenile delinquency, dependency and neglect.

The Children's Bureau first began in 1921 systematically to collect and analyze statistics of employment certificates issued to children going to work, and the number of certificating officers reporting is now large enough to indicate the trend in the numbers of children leaving school to go to work, and the extent of their gainful employment for intercensal years. Statistics for 1932 are now being tabulated and will be summarized in the forthcoming annual report of the Chief of the Children's Bureau.

Statistics on juvenile delinquency, dependency, and neglect for the year 1932 will appear shortly in the report on Juvenile Court Statistics which has been published annually by the Children's Bureau since 1927. Increasing numbers of juvenile courts are now coöperating in the Bureau's plan for uniform reporting of these statistics.

In the health field, two important studies in which much statistical work was involved, the reports of which will soon appear in print, are the study of maternal mortality, covering about 7,500 maternal deaths in 15 states, and a study of the effect of tropical sunlight on the development of bones of children in Puerto Rico. The latter is one of a series of rickets studies made by the Bureau over a period of years.

Coöperating with three other bureaus of the Department of Labor, the Children's Bureau recently assisted in a survey of the shirt industry in nine of the principal shirt-manufacturing states. The study involved an investigation of about 20,000 payroll records in 120 plants and, where available, a study of the hours worked. The Children's Bureau had charge of the statistical tabulations of the findings and of the writing of the report, which was made public by the Secretary of Labor.

Women's Bureau, United States Department of Labor.—A summary of labor legislation for women enacted between January 1 and June 30, 1933, has been published by the Women's Bureau. In at least 14 states new labor laws for women or amendments to old laws were passed during this period. Outstanding were those passed in seven states providing for the fixing of minimum wage rates for women and minors. Hour laws were amended or revised in eight states.

From information obtained from statements of two engineers, one research organization, one textile labor leader, and one cotton-mill owner, together with other facts, the Women's Bureau issued a "Memorandum on the Practicability of Setting Maximum Standards of Work in Cotton Mills Operating Under the Stretch-Out System." This study followed the raising of this question by the South Carolina State Legislature.

A survey covering the hours, earnings, and employment of workers in the cotton mills of Maine, South Carolina, and Texas in 1932 was made by the Women's Bureau in an effort to learn something of the effects of the depression in this second largest woman-employing industry. About two-thirds of all the women reported employed in cotton manufacturing in these states were included in the study.

Of these three states full-time women workers on the day shift in Maine showed the highest median of a week's earnings—$13; in Texas the median was $11.10; and in South Carolina it was $9.05.

All but one mill of the 128 reporting in South Carolina and 11 of the 13 in Texas were on a 10-hour day. In Maine 10 of the 14 mills worked a day of 9¾ hours. The operating of mills at night was far more extensive in South Carolina than in either

Maine or Texas. In the mills where women worked at night, the hours were shorter in Texas than in South Carolina. No women were reported on the night shifts at the time the study was made in Maine.

The numbers of workers in the mills of South Carolina and Texas had a higher average in the last four months of 1931 than for the year as a whole; but in Maine employment decreased somewhat in the last third of the year. Increased employment in South Carolina and Texas was largely due to increased night shift operating. Though the exact amounts of short time during the year are not known, it is evident that a considerable number of mills that operated at night in one or more departments several months of the year also curtailed employment on the day force to a considerable extent. In all three states the most frequent reason given in the mills where there was short time or reduced employment was the decreased demand for goods.

A second part of the cotton study is a survey of 14 mills in Pennsylvania manufacturing narrow cotton fabrics—tapes, bindings, braids, etc., five mills in Massachusetts and Rhode Island; and three in North and South Carolina. While a branch of the cotton industry the processes on which women are engaged in these mills were not like those in the wide goods mills and no comparison between the two can be made. The proportion of women is almost twice as high in the mills in Pennsylvania as in those in the southern states represented. Full time earnings were highest in Pennsylvania, with a median of \$13.85 and lowest in the southern mills, with a median of \$9.55. For New England the median was \$12.40 and for all sections combined it was \$12.85.

Now in press is a report on "Employment Fluctuations and Unemployment of Women." Material has been analyzed from several types of sources: The sections of the report dealing with employment fluctuations present analyses of such fluctuations in a number of important woman-employing industries, compiling data from the regular reports on these industries collected monthly by sex in three states, from several special studies also showing employment fluctuation, and from similar data for woman-employing industries in three other important industrial states that do not collect figures by sex. Reports on unemployment issued by the United States Bureau of the Census and 21 special studies on the unemployment of women made by the Women's Bureau and various other authorities, form the basis of the material shown in regard to the unemployment of women. The final section of the study cites information furnished by official reports printed or mimeographed in 22 states and giving data by sex as to activities of state-supported employment agencies. These data have been brought together to show something of what the entire picture may be.

Fellows of the Econometric Society.—The Econometric Society, an international body for advancement of economic theory in its relation to statistics and mathematics, was organized two years ago, and with a membership of economists from almost all important countries, its aims especially are to study the causes and cures of depressions. It held sessions in Chicago recently in conjunction with the American Association for Advancement of Science. Its journal is edited by Professor Ragnar Frisch of Norway, who was a visiting professor at Yale three years ago.

The present officers are Professor Fisher, President; Professor Divisia, Vice-President; Dr. Roos, Secretary; and Alfred Cowles, 3rd, Treasurer.

The Society has elected the following Fellows: Professors Luigi Amoroso of the University of Rome, Italy; Oskar N. Anderson of Varna, Bulgaria; A. L. Bowley of the London School of Economics, England; Clement Colson of l'Ecole National des Ponts et Chaussées, Paris; Gustavo Del Vecchio of University of Bologna, Italy; François Divisia of l'Ecole Polytechnique, Paris; Griffith C. Evans of Rice Institute, Houston,

Texas; Irving Fisher, Yale University; Ragnar Frisch of University of Oslo, Norway; Corrado Gini of the Instituto Centrale di Statistica del Regno d'Italia, Rome; Gottfried Haberler of Vienna; Harold Hotelling of Columbia University; John M. Keynes of King's College, Cambridge, England; Wesley C. Mitchell and H. L. Moore of Columbia University; Umberto Ricci of University of Giza, Egypt; Henry Schultz of University of Chicago; Felice Vinci of University of Bologna, Italy; E. B. Wilson of Harvard University; Dr. Albert Aupetit of Paris, formerly secretary of the Bank of France; Dr. N. D. Kondratieff of Moscow; Dr. Charles F. Roos, formerly secretary of the American Association for Advancement of Sciences, now with the National Recovery Administration; M. Jacques Rueff, attaché financier, Ambassade de France, London; Dr. Erich Schneider of Dortmund, Germany; Dr. J. Tinbergen of Scheveningen, Holland; Vice Minister of Finances, W. Zawadsky of Warsaw, Poland; Dr. F. Zeuthen of University of Copenhagen; Professor Boninsegni of University of Lausanne, Switzerland; Professor Joseph Schumpeter of Harvard University.

A Study of Health and the Depression.—A four-phase study of the health of the wage-earning population during the depression is being conducted by the United States Public Health Service and the Milbank Memorial Fund. The study embraces (a) sickness in 1933 and mortality experience, employment, occupation, and income in the period 1929–1932; (b) nutrition of children, and (c) diet and other living conditions in the families surveyed; (d) mortality of the general population in areas that can be classified according to economic status, severity of unemployment, amount of social relief, and other conditions.

The collection of field data has been completed and the results are now being tabulated and analyzed. About 12,000 families were included in the study. These families were selected from among the lower income classes in Cleveland, Pittsburgh, Morgantown and vicinity, West Virginia, Syracuse, New York City, Brooklyn, Baltimore, Greenville and vicinity, South Carolina, and Birmingham. The studies are under the direction of Mr. Edgar Sydenstricker, Director of Research of the Milbank Memorial Fund, and Dr. Selwyn D. Collins and Mr. George St. J. Perrott of the United States Public Health Service.

This study is being conducted also in coöperation with studies being carried on in several other countries under the offices of the Health Organization of the League of Nations. The American statistical committee on these studies is composed of Mr. Edgar Sydenstricker, Professor Walter F. Willcox, Dr. Louis I. Dublin, and Dr. Selwyn D. Collins.

The Brookings Institution:—The following additional fellowships have been granted for the year 1933–34: Anita Wells, University of Kentucky; Genpachiro Konno, Tokyo Imperial University; and Malcolm L. Merriam, formerly with the Bank of America.

The following persons have accepted temporary appointment to the staff of the Institute of Economics of the Brookings Institution for work in connection with the special studies now being undertaken: Aaron V. Abramson, John D. Black, Virginius F. Coe, Joseph S. Davis, Hans W. Dreyhausen, D. A. FitzGerald, Virgil Gilman, Paul T. Homan, Sherman Johnson, Edwin A. Lamke, Fred Lininger, Leon C. Marshall, Henry I. Richards, Harold B. Rowe, George W. Terborgh, Cyril B. Upham, and Max von Zabern.

Personals

The outstanding event of the statistical year has been the retirement of Professor Karl Pearson (see page 305) from the Galton Professorship at University College in the

University of London and the appointment of Dr. R. A. Fisher, for the last fourteen years Chief Statistician at Rothamsted Experimental Station, to the Chair of Eugenics in his stead. Professor Pearson's tenure of the chair has been marked by an enormous advance in the science of statistics, which largely owed its inception to his untiring energy and stimulating influence. Professor Fisher's work in the statistical field is too well known to need comment here. It is perhaps less widely realized that he has made valuable contributions to the science of genetics, as witness his theory of the evolution of dominance, and *The Genetical Theory of Natural Selection*, quite apart from his development of the theory and practice of genetical statistics.

Dr. Egon S. Pearson has been appointed to a readership in statistics at University College, University of London.

Felix Bernstein, Director of the Institute of Mathematical Statistics at Goettingen until ousted by the Nazi government, is this year engaging in research at Columbia University as visiting professor. He expects to carry on a statistical study of the relation between eye strain and old age, and also to advance the mechanical solution of partial differential equations.

Dr. Samuel S. Wilks, who as National Research Fellow at Columbia University and in England has published contributions to statistical theory, has been appointed instructor in mathematics at Princeton University.

Dr. H. Steinhaus, who was dozent in statistics and actuarial mathematics at Goettingen until the Nazi upheaval, is now in the employ of the Equitable Life Assurance Company in New York.

In May, 1933, by unanimous vote of the Council, Horace Secrist, of Northwestern University, was elected a corresponding member of the Manchester Statistical Society which was established in 1833. According to the rules of the Society, "Gentlemen distinguished for their ability and zeal in cultivating Statistical Inquiries, and living at least 20 *miles distant from Manchester, may be admitted as corresponding members.*"

Dr. Thomas Park, National Research Council Fellow in Zoölogy, is spending the present academic year in the Department of Biology of the School of Hygiene and Public Health of The Johns Hopkins University, continuing his experimental studies of population problems in the flour weevil, *Tribolium confusum*.

Miss Ruth DeWitt Pearl, assistant in the Department of Biology of the School of Hygiene and Public Health of The Johns Hopkins University, is on leave of absence for the current academic year, working in the Zoölogisches Institut at Munich, Germany.

Mr. G. M. Whitright, formerly engaged in economic and statistical work for the American Telephone and Telegraph Company and Cities Service Company, was recently employed by the United States Senate Committee on Banking and Currency on Mr. Ferdinand Pecora's New York staff which was inquiring into the practices of private bankers and into the practices of the New York Stock Exchange. At present, he is employed by the National Association of Manufacturers and is engaged primarily in labor studies.

OBITUARY

Edwin W. Kopf, late Assistant Statistician of the Metropolitan Life Insurance Company, born in Newark, New Jersey, on November 3, 1888, died on August 3, 1933,

at Chatham, New Jersey. Mr. Kopf had taken an active part in the affairs of the *American Statistical Association*. Of his extended services to a number of committees of the Association should be especially mentioned his energetic work as Chairman of the Membership Committee from 1922 to 1928; and as member of the Committee on Educational, Scientific and Professional Standards from 1924 to 1925. To the JOURNAL he contributed numerous articles and a very large number of book reviews. Among those closely associated with him he was known for his encyclopedic knowledge of insurance and particularly of insurance history and for a keenly critical mind. He entered the insurance field at an early age, in the employ of the Prudential Insurance Company of America; in 1912 he accepted a call to become chief clerk of the newly organized Statistical Bureau of the Metropolitan Life Insurance Company. Here he was largely responsible for the training of the personnel. He established high standards of workmanship and inspired many a young clerk to develop real interest and skill in the field of statistical analysis. He took an active part and a lively interest in the conduct of the *Statistical Bulletin* published monthly by the Metropolitan Life Insurance Company.

Mr. Kopf served many scientific societies both as member and as officer. He was particularly active in the establishment of the Casualty Actuarial Society of America, and for a number of years served as Member of the Council and as Chairman of the Educational Committee. He served on numerous committees for the American Public Health Association, The National Research Council, The National Safety Council, etc.

He maintained many active contacts with leaders in the field of insurance both in this country and in Europe, gaining and maintaining an international reputation for his statistical scholarship, more particularly in the field of insurance and vital statistics. Through a series of courses which he gave at Columbia University, the younger students of insurance had an opportunity of benefiting from his extensive knowledge in this field. He contributed to several cyclopedic works, among them the *American Dictionary of Biography*, for which he covered the biographies of notable persons in insurance. He also covered the same field for the *Encyclopedia of the Social Sciences*.

Mr. Kopf died a relatively young man, but with a noteworthy career behind him. In his death, insurance scholarship has lost one of its dominating figures.

ALFRED J. LOTKA

ADDITIONAL COMMITTEE APPOINTMENTS

Representative on the Council of the American Association for the Advancement of Science
William F. Ogburn

Advisory Committee to the Secretary of Labor
Ewan Clague

Committee on Calendar Reform
Meredith M. Stiles

MEMBERS ADDED SINCE SEPTEMBER, 1933

Baehne, G. W., Research, International Business Machines Corporation, 270 Broadway, New York City

Bowden, Dr. Witt, Bureau of Labor Statistics, U. S. Department of Labor, Washington, D. C.

Davis, Reverend Joseph L., S.J., Regent, School of Commerce and Finance, St. Louis University, 3674 Lindell Boulevard, St. Louis, Missouri

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REVIEWS

Pitfalls in the Statistical Construction of Demand and Supply Curves, by Ragnar Frisch. Frankfort: Frankfurter Gesellschaft für Konjunkturforschung. 1933. 39 pp.

Professor Frisch has set forth a simple, if over elaborate, mathematical exposition of the cases in which neo-classical demand and supply curves may or may not be derived from statistical price-quantity distributions. His discussion centers around the method developed by Dr. Wassily Leontief,[1] in which both the demand and the supply curve are derived simultaneously from the price-quantity data. Although certain of Frisch's criticisms of Leontief are justified, Leontief is made the target of a number of undeserved criticisms.

The first five sections state nothing new. They are rather a recapitulation, in mathematical terms, of the theory, well known to specialists in this field, that if the demand curve remains stable and the supply curve shifts, or vice versa, either the demand curve or the supply curve can be determined from the price-quantity data.[2] If both of them shift, then any observed correlation in the scatter diagram may be due to a correlation between the trends of the price and quantity series. If the shifts are uncorrelated, then there is no known method of deriving the demand and supply schedules, except by some such assumptions as Leontief's. Frisch states the problem in terms of two sets of time series: the series of prices and quantities, and the series of their respective shifts. It is then shown that the case to which any particular price-quantity distribution belongs is fundamentally determined by r, the correlation coefficient of the price-quantity distribution, p, the coefficient of correlation of the shift distribution, l, a measure of the relative violence of the price and quantity series, and λ, the relative violence of their shifts. Starting out with two linear equations for the demand and supply curves, in which α and β are the demand and supply elasticities, u and v their shifts, Frisch develops mathematical criteria for each case, and derives the elasticities. For example, when the demand curve remains constant, $\lambda=0$, $\alpha=l(r\pm\sqrt{(1-r^2)})$, and β is indeterminate.

Economists, who have had some statistical training, would find even this simple mathematical treatment more intelligible, if it were made clear at the outset that l and λ are nothing other than the ratio of the two standard deviations, or $\frac{\sigma x}{\sigma p}$; and $\frac{\sigma u}{\sigma v}$. Therefore, α, in the case stated above, becomes the ordinary regression

[1] "Ein Versuch zur statistischen Analyse von Angebot und Nachfrage," *Weltwirtschaftliches Archiv*, July, 1929.

[2] See E. J. Working, *Quarterly Journal of Economics*, February, 1927; W. Leontief, *op. cit.*; W. F. Ferger, *Quarterly Journal of Economics*, November, 1932, and others.

coefficient, if r is equal, or nearly equal to l. In any case in which $\lambda = 0$ or ∞, the elasticity to be derived is equal to the regression coefficient. This is stated by Frisch, but on the whole little attempt has been made to relate his terminology to the nomenclature of economic statistics.

The above analysis which extends over some 20 pages of Frisch's pamphlet has been very clearly and briefly stated in non-mathematical terms by Leontief himself.[1] Incidentally, his statement of the theory is quite independent of the similar analysis by E. J. Working, to which Frisch refers. Leontief very definitely restricts the application of his method to the cases in which both the demand and supply curves shift. Consequently, Frisch's statement that "if Leontief's method shall have any raison d'être, it must be through its application to the non-stability cases"[2] is in complete agreement with Leontief's own treatment.

In the analysis of the assumptions which must be made as to the nature of the two parts, into which the whole price-quantity distribution must be divided in Leontief's method, Frisch has made a real contribution. The arbitrary division of the data into two parts, with the assumption that the same elasticity exists in both, has always seemed questionable. Frisch proves mathematically that in order to derive elasticities which have any meaning, not only must the shifts be uncorrelated, but the ratio of the standard deviations of x and p, or l, and the coefficient of correlation, r, must differ significantly in the two parts. Leontief did not discuss specifically the nature of the two divisions of the price-quantity distributions which lie at the basis of his method although he stated that they should be as different as possible.[3] It may be pointed out that Frisch has thereby not invalidated Leontief's method, but has made more precise the statistical and economic considerations upon which it must be based. Frisch's third criterion for the case in which Leontief's method may be applied is the same as Leontief's, namely, uncorrelated shifts of the two schedules.

When there are distinct trends in the price and quantity series, it is indicated by Frisch that Leontief's coefficients are, one of them, the slope of this trend relation, and the other, meaningless. Leontief is not quite clear on the question of the relation of trend to his method. He seems to think that trends are taken care of by his consideration of shifting, whereas Frisch states correctly that a strongly defined trend in the two original series is one of the most important cases in which the shifts are correlated.

It is surprising to find Frisch's statement to the effect that ". . . if there is no trend relation both Leontief's coefficients are meaningless. And if there does exist a trend relation, one of his coefficients gives just this trend relation while the other coefficient is meaningless."[4] Two pages previously he summed up the assumptions on which an application of Leontief's method can be based, one of

[1] *Op. cit.*, pp. 17–21.
[2] *Op. cit.*, p. 35.
[3] It should be said, however, that Dr. Robert Schmidt has developed a method for determining the reliability of Leontief's elasticity coefficients, based on a general consideration of the two sections. (*Weltwirtschaftliches Archiv*, 1930, "Die Prägnanz der Elastizitätskoeffizienten.") Frisch dismisses this method as of little importance. Dr. Leontief has developed a further method, yet unpublished, for taking into account the nature of the two divisions of the data.
[4] *Op. cit.*, p. 30.

which is the case of uncorrelated shifts or no trend relation. Frisch appears to be denying his earlier proof. Possibly the contradiction may be explained by some sort of typographical error, with which the book abounds. It is regrettable that so many mistakes in spelling should have been allowed to remain in the final form of the pamphlet.[1]

Frisch considers that the pitfalls in the derivation of demand and supply curves "have been very nearly completely overlooked in the statistical works of recent years." His attention should be called to a number of articles appearing in current journals, most of them non-mathematical, one of which is particularly *à propos* to his present discussion. A detailed application of Leontief's and Schultz' method to the same price-quantity data was carried out two years ago.[2] It was there shown that neither method could be applied indiscriminately to all price-quantity distributions, and the assumptions of Leontief's analysis were critically discussed. It is true that the limitations of the method were not there mathematically defined, but it can scarcely be said that the difficulties were "nearly completely overlooked."

It is good to find Frisch joining the select company of those who emphasize the necessity of using mathematics with extreme care in connection with economic data. His statement upon the subject is worth quoting:

> In this field we need, I believe, a new type of significance analysis, which is not based on mechanical application of standard errors computed according to some more or less plausible statistical mathematical formulae, but is based on a thoroughgoing comparative study of the various possible *types of assumptions regarding the economic-theoretical set up*, and of the consequences which these assumptions entail for the interpretation of the observational data.[3]

If mathematicians who have turned economists would hang this as a motto over their desks, the extension of mathematics into the general field of economics would be considerably accelerated. Unfortunately most of them are more occupied with the niceties of mathematical development than its significance in actual economic terms. It should be said here that Leontief paid considerable attention to the economic bases of his method, and ought not to be classified, as the reader is led to infer, with those who indulge in the blind use of statistical method.

There are a number of other "pitfalls" which might have engaged Frisch's attention. The problem of trend elimination, to mention only one of them, in an attempt to isolate what he calls the "Cournot effect" in the price-quantity distribution, is one of great importance. If trend is eliminated, are not at least part of the shifts of both the demand and supply schedules also eliminated? And how, then, can the criterion of "relative violence" of shifts be applied? It is also to be noted that the existence of trends in the time series of prices and quantities does not necessarily cause them to be correlated. The reviewer has re-

[1] For instance, p. 12, "pramoters" for parameters; p. 15, "exkibits" for exhibits; p. 16, "may" for way; p. 18, "abtained" for obtained; p. 19, "trival" for trivial; etc. Also, accents are omitted whenever French phrases are used.

[2] E. W. Gilboy, "The Leontief and Schultz Methods of Deriving Demand Curves." *Quarterly Journal of Economics*, February, 1931.

[3] *Op. cit.*, p. 30. See also a very similar statement by F. Divisia, "Economique et Statistique," *Revue d'économie politique*, 1932, p. 1481.

cently dealt with series in which distinct trends were noticeable, but very little correlation was evidenced in the price-quantity distribution.

On the whole, it may be said that Frisch provides quite a useful mathematical statement of the relation between equilibrium theory and statistical data. He also develops definite mathematical criteria for the classification of price-quantity distributions as ones from which classical demand or supply curves may or may not be derived. Used in conjunction with all the economic material available, these criteria should prove useful to economists interested in this problem.

ELIZABETH WATERMAN GILBOY

Harvard University

Public Utility Regulation, by William E. Mosher and Finla G. Crawford. New York: Harper and Brothers. 1933. 612 pp.

Public utility industries and their regulation form a field of inquiry which has only recently come to be recognized as separate and independent. The sign and portent of this status is the appearance in college catalogues of courses on Public Utilities and their inseparable attendant, the college text book. *Public Utility Regulation* is not likely, I think, to be an altogether satisfactory text book. It is neither insipid enough nor platitudinous enough to measure up to the long established and well tested standards for this type of work. In fairness to the authors it should be said that the writing of a text book on the subject was probably not their main intention. A considerable knowledge of the elementary facts and problems of the field is taken for granted, and the authors are more interested in weighing the effectiveness of regulation than in expounding to the beginner the A B C of the subjects.

In this epoch of "crises" of various sorts the crisis in public utility regulation has established itself as one of the most authentic. Professors Mosher and Crawford are peculiarly well equipped to analyze the nature of this crisis. Both of them closely associated with the intensive New York public utility investigation of 1930, they are able to unite an intimate, practical knowledge of the subject with the requisite economic, legal, engineering, and accounting training. Although the book rather stresses the administrative aspects of regulation, it is not at the expense of the legal and economic. Indeed, in their handling of the tricky problems of valuation and rate structures, the authors reveal themselves as better economists than most.

The field of public utilities is a singularly amorphous one, and books on the subject, including this book, inevitably reflect this formlessness. It is a field from which good lawyers tend to emerge as half-baked economists and good economists as half-baked lawyers. The concept of public utility industries is not a clear-cut economic concept, and the economic problems of these industries give the appearance of being torn from their context by the exigencies of public policy. On the legal side we have the spectacle of the courts wrestling with new problems and concepts alien to our law only to emerge with decisions which

are neither good law nor good economics. It is a field created by and imbued with the spirit of the practical demands of public policy. In this field Professors Mosher and Crawford step with admirable care, and if their book, which is the best on the subject yet to appear, seems a little shapeless, it is not their fault but the fault of their material.

As a study of the problems and difficulties of administration, it is altogether admirable. The analysis of the personnel of state regulatory commissions and of the qualifications necessary for effective administration throws new light upon a heretofore neglected aspect of regulation. More attention is paid to the very difficult and important question of the proper division of power between regulatory authorities and management than in any previous general treatise on the subject. The relation of the commissions to the courts is treated briefly but succinctly. The authors are not only critical in their handling of commission administration but intelligently constructive in their suggestions for reform.

There is nothing new in the treatment of the more familiar aspects of public utility problems, valuation, and rate making. But the authors succeed in presenting clearly the issues in the valuation controversy and handle competently the economics of utility rate structures. The chapters on holding companies were written without benefit of a careful study of the new material collected by the Federal Trade Commission, but it is doubtful whether such a study would add much to the treatment of the subject. The authors, perhaps, err slightly in striving too hard for completeness. Most of the last section dealing with special problems such as grade-crossing elimination, rural electrification, and the like, could have been left out without damage to the book.

EDWARD S. MASON

Harvard University

The Triumph of Mediocrity in Business, by Horace Secrist. Chicago: Bureau of Business Research, Northwestern University. 1933. xxix, 468 pp.

Contrary to the Marxian doctrine that capitalism is unstable and bound to explode, the reader of this and the author's previous books on the subject gathers that a remarkable tendency to stability holds sway. Numerous graphs such as those on page 445, which show a distribution of department stores for each of six successive years with regard to ratios of expenses to sales, display lines which come together irregularly but unmistakably. Similar charts and numerical tables show convergence from year to year during the War and post-war period for a great variety of business ratios connected with department stores, retail clothing, retail hardware, and wholesale grocery stores, banks and railroads; also for the variables of agricultural economics, arrayed by states. The labor of compilation and of direct collection of data must have been gigantic.

The inference appears to be that extreme deviations from the average tend to disappear, while mediocrity triumphs. We read on page 38:

> Regression to type characterizes such series, it being the prevailing tendency of ratios which are relatively high to decrease, or to increase less than those which are low; and of those which are low to increase, or to fall less than those which are high.

And in the preface:

> The tendency to mediocrity in business is more than a statistical result. It is expressive of prevailing behavior relations.

This conclusion, if true in the sense in which the reader naturally interprets it, would be of immense importance. But unfortunately the caveat must be added, though it is not added in the text, that while the concerns at the margins of the group, if they remain in business, often go toward the center, those in the center of the group also go toward the margins. Some go up and some down; the average of the originally central group may, therefore, display little change, since the positive and negative deviations cancel in averaging; while for an extreme group, the only possible motion is toward the center.

The converging lines in the graphs are averages of groups, arrayed according to the value of the variable in the first year of the series. If the concerns were arrayed according to the values taken by the variable in the last year of the series, the lines would diverge. Thus from the same data one may demonstrate stability or instability according to taste. The seeming convergence is a statistical fallacy, resulting from the method of grouping. These diagrams really prove nothing more than that the ratios in question have a tendency to wander about. If one compares the stores or banks to a cluster of stars, one must not think of them as falling together in a resisting medium toward their common center of gravity, but merely observe that they move about within the cluster. If those remotest from the center are watched for a time, their average distance from the center will naturally decrease; but it does not at all follow that the cluster is contracting.

The real test of a tendency to convergence would be in showing a consistent diminution of variance, not among means of groups, but among individual enterprises. Diminishing variance among means of groups is entirely consistent with a stationary, or even an increasing variance of the whole. In certain of the tables are presented standard deviations and average deviations of the whole sample in successive years, though little attention is devoted to them. The strongest contributions to the thesis of convergence are the values of these measures of dispersion on pages 73 and 142, which decrease each year from 1920 to 1924 inclusive, and in some cases also in 1925. However, the changes in dispersion are so slight as conceivably to be attributable to sampling fluctuations. On the other hand, the table on page 166 of ratios of net profit or loss to net sales for 49 identical department stores gives the average deviation for each year from 1920 to 1930 inclusive; and these fluctuate most irregularly Fitting a trend line to them would seem to show an upward rather than a downward tendency in the variance, though with great irregularities. The clothing store dispersions on page 193 for 1916–22 likewise show considerable fluctuation and an apparently rising, though doubtful, trend. There are a few other tables of average or standard deviations, which also fail to support the thesis of convergence.

The technique of following graphically the means of initially arrayed groups is defended by applying it to temperatures of cities, and noting that the groups

of cities which were hottest or coldest in the initial year remain respectively the hottest or coldest throughout. But this means merely that the cities do not move about, while business ratios do. To revert to the analogy of the star cluster, we should for this temperature study have to hold each star within a small fixed region. The argument that business ratios converge because the means of initially arrayed groups converge is definitely incorrect.

The thesis of this and of some preceding work by the author can be made true by interpreting it to mean merely that averages of groups chosen in this particular way converge. This conclusion is mathematically obvious from general considerations, and does not need the vast accumulation of data adduced to prove it. These volumes clearly represent immense labor in collecting data, computing, and drawing graphs. It is to be hoped that the material can be used for other purposes than to prove that business is stable, and will be treated by sound statistical methods.

HAROLD HOTELLING

Columbia University

Minor Papers on the Currency Question, 1809–1823, by David Ricardo. Edited with an Introduction and Notes by Jacob H. Hollander. Baltimore: The Johns Hopkins Press. 1932. ix, 231 pp.

Professor Hollander has rendered fresh service to the history of economic thought by editing and publishing Ricardo's Minor Papers on Currency. "The recovery and publication, in 1928, of the long missing and much-desired manuscript of David Ricardo's 'Notes on Malthus' was welcomed [Dr. Hollander points out] by close students of the Ricardian economics as filling gaps and as clearing doubts on the doctrinal differences of its chief figures. In conjunction with the 'Notes on Malthus,' a considerable body of additional Ricardo material, manuscript and printed . . . was brought to light. This matter is now made available through the continuing courtesy of Frank Ricardo . . . a great grandson of the economist." The material in question centers around the currency problem, and thus warrants the title of the present volume, though it is not exclusively devoted to monetary discussion. Some of the material, as the editor notes, is mere scraps or scanty marginal comment on other authors, some has been published in contemporary letters to newspapers, and some was apparently left in fairly complete form, titled and paged. Various as it is in value, the text of these "remains" taken as a whole, is a valuable supplement to the Ricardian contribution to the currency and monetary problems of the time and furnishes many a connecting link, heretofore missing, for the use of those who would reconstruct the intellectual history of British monetary economists and economics during the first quarter of the nineteenth century—that period when so many doctrines destined to play controlling parts in the history of capitalistic thought were in the making. It should be added that many a wise word bearing directly upon current monetary discussion may be culled from these fragments and commentaries, framed as they were in circumstances

strangely similar to some of those which must be met and analyzed today.

The reader of this volume will find the several items it contains of greater or smaller interest and concern, according to the direction which he has given to his own individual studies. Yet most such readers will, on the whole, find largest significance, probably, in the commentaries upon the Bullion Report, and in the letters published in the *Morning Chronicle*, and dealing with various topics of contemporary interest in the field of money and banking. To these the discriminating will add no doubt the Plan for a National Bank already well-known but now offered prefixed with a skeleton outline, and completed by a brief supplementary note. The comparisons of the views of Ricardo and Torrens on "The Measure of Value," and the correspondence between Ricardo and J. B. Say must likewise be included in any selection of choice bits that will please the taste of the general economic reader.

It is, of course, largely out of the question to read these fragments of Ricardian economics, without first having or refurbishing a fairly extensive and critical knowledge of the writing and point of view of the author, at least in those tracts of thought which are chiefly dwelt upon in these extracts. So equipped, however, the reader of the volume finds his memory and his critical historical sense sharply stimulated by the suggestive side-lights that are thrown by this collection not only upon Ricardo's own ways of thinking, but also upon the whole currency and banking controversy in which the work of the Bullion Committee was a central feature. As is now made clear, Ricardo, far from holding aloof from the practical discussions of the day surrounding the questions of immediate legislation, was a continuous and acute commentator upon them, and through correspondence, newspaper contribution, and critical analysis of the work of his contemporaries, did much to shape and direct the current of British thought into safe and well marked channels.

It may well be doubted whether these fragments will change in any large particular the general opinion of Ricardian doctrine on the topics dealt with. That was already clear, and had been too deeply appreciated through long-continued exegesis to be much altered by anything save the discovery of some major work whose existence or content had not before been imagined. As has been said, there is here nothing of the sort, but the data supplied will none the less serve as valuable additions in many directions to the stock of information available to Ricardian students. The essays and articles previously published are given greater value by the fact that they are now organized and arranged by a sympathetic hand in their proper logical and chronological relationships, so that their meaning may stand out definitely upon the background of the economic history of the period.

Economic thinking and economic and financial history are being steadily more closely linked by careful groupings of fugitive but essential materials like those contained in this collection. It is the new way of writing biography—from some points of view, the best.

H. Parker Willis

Columbia University

Direct Taxation in Austria, by John V. Van Sickle. Cambridge: Harvard University Press. 1931. ix, 232 pp.

This volume from the pen of the Assistant Director for the Social Sciences of the Rockefeller Foundation was awarded the David A. Wells Prize at Harvard University. The stated purpose is "to show how closely the public finances reflect the changing political fortunes of the various classes in the State and how vitally they affect the production and distribution of wealth" (p. vii). The period which is intensively analyzed is that immediately following the Great War, from the Armistice until the initiation of control by the League of Nations in 1922.

A background is first sketched in a chapter describing the direct tax system as it stood in 1914 and in a few pages devoted to developments during the war period. The post-war history is then introduced by an excellent brief description of the political and economic situation. Three substantial chapters, entitled, "The Direct Taxes in Republican Austria," "Concessions to Capitalistic Enterprise," and "The Capital Levy," contain the bulk of the results of the author's study and a final chapter summarizes his conclusions.

All will readily grant the extreme difficulty of the task which the author has attempted. Merely to describe accurately and clearly the tax system and its modifications is a technical task requiring much skill. But Dr. Van Sickle also essays the more delicate operation of tracing the responsibility for the changes made and their effects upon the various economic interests—and this, moreover, for a foreign country and during a period when extreme inflation was agitating the economic system. Finally he even aspires to appraise the record and to register a judgment, plentifully adorned with adjectives, as to the wisdom and foolishness of what was done. To undertake such a task requires courage and self-confidence of a high order and these Dr. Van Sickle certainly possesses. To carry it through with distinction requires qualities which no man can be expected to reveal, at least in his first book.

The manner in which the author disposes of highly doubtful and controversial questions reveals the "passion of youth for finalities" in an extreme form (see, *e.g.*, pp. 14, 16, 34, 47, 65–6, 73) and the emphatic judgments of the author would sometimes carry more conviction if he exhibited a higher degree of clarity or consistency in the norms he utilizes in assessing quality (*e.g.*, pp. 20–1, 39).

In his discussion of the capital levy, which is by all odds the best section of the book, Dr. Van Sickle reaches conclusions highly unfavorable to this device. The capital levy, in his view, is both inequitable and impracticable. It is inequitable, first, "because in an emergency all should contribute to the salvation of the country" (p. 170). The professional man on a large income is not effectively reached and, if he could be reached, it would be necessary for him to borrow in order to pay. Moreover, he contends, it is inequitable because different types of property will be assessed with different degrees of fullness and precision as American experience shows. The capital levy, he asserts, is impracticable, first, because of administrative difficulties—"Its high rates arouse

the resistance of all those liable to it" (p. 170); second, because its financial results have been disappointing wherever tried; and, third, because, since it is "*seriously advocated only in countries which are in a desperate plight*," it cannot expect efficient administration for if efficient administration were available, *the country, forsooth, would never have gotten into a desperate plight!*

With respect to all of this, the puzzled student of taxation may be permitted to interpose *a few interrogation marks. Is the test of net assets alone less* equitable than the test of net income alone and may it not be the part of wisdom *and justice not to discard the test of net assets because it fails to reach those* without accumulations? If American experience proves the impracticability of an appraisal of *net assets (which, by the way, it probably does not)* what is the significance of the experience of Germany with her *Vermögensteuer* and the experience of Switzerland with her *impôt sur la fortune? Is* it impossible to adjust the rates of a capital levy so that it will not "arouse the resistance of all those liable to it"; may not these *rates vary greatly with the circumstances?* Were not the circumstances hopelessly unfavorable in Austria? If, by chance, the levy should be "seriously advocated" and adopted in a country whose "desperate plight" is not caused by the breakdown of the administration of its direct taxes, can efficient administration of the levy be anticipated?

Similarly, the author's confident assertion (p. 190) that the "only policy capable of rescuing the country" was a long-time loan raises a series of queries regarding the validity of the assumptions involved. Again when he contends that "any attempt" to make direct taxes "the chief source of revenue in a period of depreciation . . . is bound to imprint upon them such a pronouncedly anticapitalistic character as to destroy any last vestiges of confidence of the possessing classes in the State . . . and to increase the tempo of depreciation" (p. 204) one wonders whether the author is not slightly intoxicated by strong language. Any attempt? Any degree of depreciation? Any last vestiges of confidence? Any possessing class? In any country? Under any circumstances?

The section dealing with the relations of state and local taxation is interesting and well done although it is difficult to understand why it is included under the general chapter heading of "Concessions to Capitalistic Enterprise."

Little care has been lavished on form. There are numerous instances of obscure statements susceptible of more than one interpretation. Unfortunately this lack of precision and clearness often occurs in statements of a statistical nature introduced for the very purpose of adding precision to vague adjectival phrases. Speaking of the 1910 increase in the income tax, which was accomplished "by the simple process of adding extraordinary surtaxes to the existing rates," the author says: "On incomes above this amount (3,000 crowns) the increases began with 15 per cent and rose to 120 per cent on the fraction above 200,000 crowns" (p. 47). To what these percentages applied is not stated. One may infer that they applied to the yield of the normal tax and not, as would at first appear, to the original income base, for "120 per cent on the fraction above 200,000 crowns" is rather high, even in war time! On the same page this statement appears: "*More significant, however, were the*

progressive additions on profits[2] above 6 per cent of capital and reserves." The footnote referring to "profits" reads: "The term 'profits' as used here meant the *ratio* (italics mine) of net profit, less corporation tax and interest on borrowed capital, to invested capital." Again it is stated (p. 51) that "The war profits tax on corporations was originally (1916) levied on *relative increases* of earnings." The rates (percentages) were not, of course, applied to a *ratio* or levied on *relative increases*. They were applied to profits in excess of a standard. At another point (p. 44) the author writes: "available fats and oils dropped from a tenth to a fifteenth of the pre-war quantity." Apparently what he meant was that they dropped to a level which was somewhere about a tenth or a fifteenth of the pre-war quantity. On page 88, speaking of the business tax, the author says: "There was little active discontent, however, because the slow increase of the contingent by 2.4 per cent every two years made the burden steadily lighter." Of course, it was not the slow increase of the contingent which made the burden steadily lighter. Other factors, such as the increased profitableness of business, more than offset the influence of the slow increase of the contingent. In several places the author speaks of "depreciation" in a fashion which makes it difficult to determine whether he refers to the monetary unit or to business assets (pp. 92, 150).

If he is sufficiently patient, the informed reader will be able in most cases to arrive at the meaning which the author intended to convey. However, the casual reader may sometimes be led astray and even the competent student will resent the unnecessary strain imposed upon him by the author's occasional lapses into loose writing.

In at least one case the fault is more serious than mere ambiguity or obscurity. On page 74 one reads: "Food subsidies were responsible for almost 30 per cent of the deficit—21,700 millions in a budget of just over 70,000 million crowns." Twenty-one million seven hundred thousand is indeed about 30 per cent of 70,000 millions but the 70,000 millions happens to be the total expenditures of the budget and not the deficit. The deficit, according to Dr. Van Sickle's figures on the preceding page but one, was 41,117.5 millions so the subsidies were responsible for not 30 per cent but nearly 50 per cent of the deficit.

Errors in typography and orthography are more frequent than is easily excusable. See, for example, "incidents" for incidence (p. 99); "affected" for effected (p. 133); "consummation" (p. 64); "none . . . hold" (p. 183). On page 127, the reader is referred to a table on a page where no table appears. On page 34, line 19, "income tax" apparently should read "building tax" or *vice versa* in line 15.

The reviewer is not competent to pass upon the accuracy of the author's detailed description of the Austrian statutes. This task must probably be left to the Austrians themselves.

In spite of the blemishes of form and the irritating character of some of the pronouncements, the volume adds substantially to our knowledge of continental tax systems and is, on the whole, a promising and a stimulating piece of work. It is certainly the product of a vigorous and courageous mind. Students of taxation will look forward to Dr. Van Sickle's more mature contributions with

the hope that, in the fullness of years, caution and precision may be added to vigor and courage.

Robert Murray Haig

Columbia University

Agricultural Systems of Middle Europe: A Symposium, by O. S. Morgan, Editor. Foreword by Honorable Arthur M. Hyde. New York: The Macmillan Company. 1933. xix, 405 pp.

This is a very important book for those who want a condensed, factual statement of the economic and social significance of agriculture in the eight countries of Middle Europe. These countries are Austria, Bulgaria, Czechoslovakia, Greece, Hungary, Poland, Rumania, Yugoslavia. Each country is described by a qualified expert residing in that country, usually a professor of agricultural economics or a person of high position in the Ministry of Agriculture.

To make these eight stories fit into a somewhat uniform pattern, the editor of the symposium furnished to each author an outline covering these heads: physical factors; population; land utilization; agriculture in the post war years 1918–1931; land reform; production, marketing; coöperation; taxation, insurance, and credit; education; agrarian politics; farm income; future outlook for farmer; problems of Pan-Europa. The book is more than a mere inventory of facts, although the editor has evidently intended it to be a book of reference rather than a volume of popular readings. Facts are selected, organized and presented so that broader principles of economics and politics emerge.

For example, the student of agricultural education can piece together a fairly full picture of this type of education in these eight countries. So also can the student of coöperative marketing, of farm credit, of state aid, of wheat marketing, and so on, do with his particular subject. Space is lacking to quote at length, but many passages are worthy of quoting in full. Only a few of the topics can be even mentioned in this brief review.

The strip system of farming in vogue in many parts of Europe has always been a source of critical comment to American observers. This subject is fully treated in this book. In Bulgaria, says the author,

> The land of the typical individual farm holding is not in one piece nor in a few compact pieces of land, but is in many small and scattered fields. The number of fields used for the various crops in their respective farm area classes ranges from 2.6 fields in the smallest farm size class (2 to 5 acres) up to 29.4 separate fields in the 75–250 acre group.

The expropriation of estates, following the War, was a drastic step to elevate the status of the peasant. In some cases production was decreased thereby. The authors report some favorable results in Rumania, Yugoslavia, Czechoslovakia, Greece and Poland. The author for Bulgaria (Professor Dr. J. S. Molloff) is not so sure: he says:

> The Land Reform has exercised and will continue to exercise a powerful influence upon many classes of population, both producers and consumers. Such an important social shift cannot be imagined, and it did not occur here, without

> an avalanche of dissatisfaction and real or imaginary grievances and injustices. The readjustment of the relative proportion of the various farm categories either strengthens or weakens entire classes of population, and also affects the productive capacity and social equilibrium of the country. It can not be summed up. It is entirely too complicated to find the exact principles and leading ideas that would give even a superficial insight into the work that has been accomplished and especially the longtime influence of the reform.

In all eight of these countries the expropriated estates were paid for. However, in Bulgaria, under the 1921 law, a supplemental graduated so-called "capital levy" was made on the large estates, taking from 15 to 20 per cent of them without compensation.

The number of agricultural workers per 100 acres of cultivated land is given for 24 countries, including these (note the low proportion for Great Britain):

Yugoslavia	16.5
Bulgaria	23.7
Rumania	16.0
Poland	17.5
Austria	9.1
Hungary	11.5
Czechoslovakia	11.5
Great Britain	3.1

The valorization of currants in Greece, the abolition of feudal servitudes in Poland, the ancient and wasteful strip system of land tenure, the relation of transport to progress (internationalization of the Danube), the delectable plum marmalade of Yugoslavia—these are samples of the topics which even the laymen find interesting.

A "planned" agriculture and a "rationalization of production" come in for much attention. Take wheat, for an example. In July, 1930, the first Danube Conference was held at Bucharest, three countries participating; the second conference was held in Yugoslavia in August, 1930; the third was held at Warsaw in August, 1930, eight countries participating. Then the League of Nations General Assembly took up the question of wheat in September, 1930. The fourth conference was held at Bucharest in October, 1930. Then the scope of these conferences widened into "Agrarian Conferences," continued at Sofia in December, 1931. A Wheat Pool for each country was recommended, and actually carried into operation in Poland and Yugoslavia. Now a Central Pool is being considered for such state pools as may be formed, in order to deal with the wheat surplus problem more effectively. Apparently the lesson of the late Canadian Wheat pool is lost on these countries.

Running through this book is the note of New Nationalism. New boundaries, enlarging some countries, diminishing others, have created new political units by destroying old economic units. Hungary is the outstanding example. Says the author (Dr. Ivan Edgar Nagy):

> As a result of the World War this classic form of economic unity was pulled into pieces that are absolutely deprived of any economic unity . . . Deprived of raw materials, forests, extensive pastures, surrounded by fantastical boundaries, residual Hungary is completely isolated both politically and economically . . . Hungary became the victim of the so-called "peace treaty" of Trianon.

> . . . The Trianon peace has robbed Hungary of 2/3 of her former territory. Her population decreased from 21,000,000 to 8,000,000. About 4,000,000 Hungarians have been forced under foreign rule as a consequence of the treaty. Hungary has lost 50.30 per cent of her arable lands, 69.42 per cent of her pastures, 84.88 per cent of her forests, 74.53 per cent of her meadows, and 73.87 per cent of her gardens. Practically all of the former territories that supplied Hungary with necessary raw materials such as minerals, salt, lumber, etc., have been segregated from Hungary. Annual imports of lumber cost more than the entire income from Hungarian cereal export . . .
>
> Everybody in Hungary is imbued with the loyal purposes of the Pan-Europe movement and everybody knows the importance and necessity of peaceful economic coöperation with other nations . . . There is no Hungarian who would not trust that justice will be obtained by Hungary, and that this justice will soon come. This belief, this strong trust, is the lodestar of the thousand-year old Hungarian nation and this gives it the moral power to fight the struggle for its existence and for the recovery of its rights that have been trampled in the dust.

This new political nationalism, fatal to old economic nationalism, gives rise to two movements; one, to develop by slow and painful steps a new economic nationalism; the other, to create, by economic ententes, a Pan-Europa. Particularly do these eight agricultural States with their hundred million inhabitants, argue with the "big industrial states" of Europe for such a solution of their problems. Thus far the outlook is discouraging. Say the Rumanian authors (Dr. A. Frundianescu and Professor G. Ionescu-Sisesti):

> Instead of considering these arguments for a United States of Europe, and despite constant recommendations of international conferences and competent organizations of the League of Nations, there is a continued growth in protective tariffs which closes the frontiers to the agricultural products, or which hinders their entrance by very reduced profits, and which does not realize the value of the labor of the agriculturists.

The editor of this symposium, Professor O. S. Morgan, is especially well qualified for his job, by reason of his wide acquaintance in Middle Europe, and his technical training in agricultural economics. He has undertaken a work of great and unusual difficulty, and he has had a large measure of success. As the pioneer in this field, he has made the way easier for those who will come after him. With the exception of the first article in the Symposium—the Austrian—he has secured a translation of his material into clear, idiomatic English.

JAMES E. BOYLE

Cornell University

Straw Votes: A Study of Political Prediction, by Claude E. Robinson. New York: Columbia University Press. 1932. 203 pp.

Measurement in the field of political science is still in the stage of development. New statistical techniques and devices are needed to apply to political phenomena. Most of the studies in this field have used as their unit of measurement the vote, particularly the popular vote and the vote in the legislative assembly. The present study is a pioneer work in the measurement of voting intention, as Professor Chaddock calls it in the "Foreword," and its relation to political prediction.

The straw poll is comparatively inexpensive technique by which popular sentiment on issues or candidates may be secured without going to the stupendous task of canvassing every voter. The legislator, as Mr. Robinson points out, could use it to test the sentiment of his constituency on matters of major importance. The politician could use it to make more reliable the gauging of the election results, and thereby make stronger efforts where they are needed. Straw votes are useful to the newspapermen in that the reporting of the polls are of great interest to readers. And for the student of politics, "the straw poll may serve as a measure of sentiment whereby the workings of public opinion in response to electioneering may be better understood."

Straw polls have been taken on all sorts of issues and campaigns since as early as 1904. Newspapers, weekly magazines, and other organizations have sponsored these straw polls. There have been other political predictors, however, and among these are the politician, the newspaperman, and the political barometer "As Maine goes, so goes the nation." A study of each of these methods of predicting the outcome of elections was made and described in the present work. Politicians were found to be the most inaccurate predictors, while newspapermen were inaccurate for predicting electoral college votes but picked six winners out of the last seven presidents. The Maine barometer was found to be unsatisfactory as a predictor of election results; it is not as sensitive an indicator of national feeling as many persons believed. The *Literary Digest* and the Hearst papers were found to be the most accurate when the various methods of predicting the outcome of elections by the use of the straw poll were examined.

The main problem in political prediction by using the straw poll is one of sampling. Mr. Robinson discusses five specific sampling problems which he noted in his investigation: first, the geographical bias (cities polled more than rural districts); second, the class bias (certain economic groups are polled because of their availability through commercial mailing lists); third, the bias of selection in coöperation (certain classes of people may coöperate with the poll sponsors more readily than others); fourth, the bias of participation-nonparticipation (people may vote in the straw poll and not be eligible or care to vote in the final election); and, fifth, the size of the sample may be too small to be used for prediction purposes.

The task of conducting this investigation on straw polls consumed more than three years. Gathering the data for such a study was a stupendous task. An examination of the many tables of percentage distributions which the author presents is sufficient to convince the reader that the book contains a very exhaustive study. But with all the data collected the reader has a feeling that much more could have been done with them. A rather simple technique of comparing the accuracies of prediction is used throughout the book. No use is made of any refined techniques which would have made the book more of a contribution to this new field of measurement in politics. The discussions of the various causes for errors in prediction and how they may be remedied does not measure up to the problem the author is treating. Remembering that this investigation is a "pioneer work" in this field one can be well

satisfied with the presentation; but, on the other hand, with the wealth of material which must have been collected, it seems that there could have been a more critical analysis.

RICHARD O. LANG

University of Chicago

Taxation of Motor Vehicle Transportation. New York: National Industrial Conference Board. November, 1932. xii, 196 pp.

The American people may have a predilection for uniformity and standardization in certain matters, but the taxation of motor vehicle transportation is not one of them, as this study, largely statistical, amply shows. The Board has here gathered together a large amount of factual material, much of it by correspondence with state officials, and the resulting collection of 43 tables reveals in a striking manner the disparity of practice among the several states, particularly with reference to the license taxes. Many of the tables concern legal and administrative provisions of the license and motor fuel taxes. Since most of this information is not readily available elsewhere, the student of motor vehicle taxation will doubtless find the volume indispensable for reference purposes.

The text is largely a summary of the results revealed by the tables. The Board does not attempt to push very far into the troublesome theoretical aspects of distribution of the highway burden, although it cites certain arguments for and against a number of propositions, and draws heavily on a recent study by the Interstate Commerce Commission. In places certain important considerations are omitted, as for instance the justification of the license tax as a levy on the week-end driver who is the cause of a heavy overhead expense on roads usually employed far below capacity. On the whole, however, enough of the major problems are noted so that the reader should obtain a bird's-eye view of the complexity of the entire problem.

Most of the legal and administrative tables are admirable in their arrangement and comprehensiveness. Some of the statistical tables, or rather the summary figures that are drawn from them, are, on the contrary, open to serious misunderstanding, largely owing to the use of unweighted averages. Discussion in this field is often so clouded that it seems advisable to draw some attention to the point. On page 101, for instance, it is stated that "For trucks with pneumatic tires, the average tax was \$521.30 on those operated as common carriers, or 33.7 per cent higher than on contract carriers [\$389.99]. . . ." This result is reached by averaging, without weights of any kind, the taxes paid in each state on a hypothetical vehicle—or in other words, each state is given a weight of one. The apparently much heavier burden on common carriers results chiefly from the fact that a few states, most of them small—Arizona, California, Colorado, Iowa, Maryland, Minnesota, North Carolina, South Carolina—levy drastically heavier rates on common carriers. But Massachusetts, New Jersey and New York tax both contract and common carriers at the same rate, Ohio and Pennsylvania show only a slight differential against the common carrier, and the Board's table includes no data for

Illinois. The first group of states had a population of 19 millions in 1930; the latter group, 45 millions. The danger is, of course, that someone may point to the Board's percentage figure as indicative of a nation-wide heavy burden upon common-carrier truckers as compared to contract carriers. In reality, this percentage figure gives virtually no information of value at all. The same type of criticism can be made of other average tax and percentage figures on pages 161 and 162 and of those on page 18.

Doubtless, population is not the best weight, but surely the averages and percentages would be better omitted entirely unless some satisfactory method of weighting could be found, and the reader should at least be warned of the consequences of trying to use these unweighted averages.

The statement on pages 13-14 that net weight ranks first in frequency of use as a weight measure of the license tax, with 72 applications, whereas gross weight comes second with 69, is literally accurate, but possibly misleading to the casual reader, inasmuch as Tables 5 to 10 show that in 16 of the 72 cases the net weight measure is combined with either tons capacity or passenger capacity, which gives much the same result as if gross weight were used. On this basis gross weight would have a commanding lead of 85 to 50.

CARL SHOUP

Unemployment in Germany Since the War, by Kenneth Ingram Wiggs. With an Introduction by Henry Clay. London: P. S. King and Son. 1933. ix, 216 pp.

"The purpose of this study," says the author, "is to find a satisfactory explanation of the high amount of unemployment in Germany since the War" (p. 13). Incidentally it also served as a thesis for the doctorate at the University of London. In the first third of the book are set forth the facts as to the amount and distribution of unemployment and the general state of trade in Germany during the period 1903-31. The rest of the volume is given over to the aforesaid explanation. In its descriptive aspects the work is highly competent, but the analysis, in the opinion of the reviewer, is not altogether convincing. Well planned as a whole, the chapters are rather drearily subdivided; at times, too, there is infelicity in the use of English. This may be due to the urgency, which the author says he felt, to publish at the earliest possible moment.

As a basis for his accurate and detailed description of the facts of unemployment in Germany, Dr. Wiggs employs, for the years 1903-24, the trade union *percentages of members out of work*. For the period since 1924 he uses, in addition, the statistics of the Ministry of Labor as to the numbers of persons seeking employment. The unemployment aid and insurance figures, published since 1919, he ignores because of limited range and frequent changes in the eligibility rules; he disregards for other reasons the statistics as to persons compulsorily insured under the National Health Insurance system, and the Index of Labor Exchange Activity. Various special inquiries are taken into account.

A preliminary survey of the state of the labor market from 1903, when the trade union percentages were first published, until 1914, brings out certain points of comparison with post-war conditions. First, it is clear that seasonal unemployment was at all times a serious matter—more serious than in Great Britain—but not relatively more burdensome after the War than before it. Second, the long-period fluctuations of employment have been more violent in recent years than they were prior to 1914. And last, the problem of basic, or "residual" unemployment has attained proportions which, despite the impossibility of accurate comparison, are probably more serious than in pre-war times. Extreme localization of unemployment, as in England, is not found in Germany.

As a first step toward explanation of the situation thus portrayed, Dr. Wiggs expresses skepticism as to the approach through cyclical analysis. It is his view that the phenomena of the post-war labor market can best be interpreted in terms of three non-cyclical factors, namely, monetary conditions, scarcity of capital, and high and rigid wage rates. The relatively low level of unemployment from 1919 to 1923 he ascribes to inflation, and the enormous increase in the numbers of the workless at the end of 1923 to the reversal of the relationship between wages and external and internal prices. The serious depression of 1925–26 was due to the necessity for reorganization following stabilization. And here the influence of domestic monetary conditions, as a major factor, ended.

From 1926 to 1929 was a period of recovery, conditioned by capital scarcity and rapidly rising wages. The causes of the lack of capital Dr. Wiggs examines in detail. He criticizes the Germans for reckless borrowing and censures the public authorities for their spendthrift policy in the social services and public works. He emphasizes the rôle of high interest rates in making it difficult for borrowers to cover costs, and the tendency of short term capital to be withdrawn suddenly, thus harassing employers and increasing fluctuations of employment.

High and rigid wage rates, however, due to the new strength of the unions, the spread of agreements and the support of the state, make up the main burden of the author's complaint. In the first place, during expansion they hindered saving and diminished employment. Moreover, from 1925 to 1929 average real-wage costs rose from 83.7 to 119.9 (1913=100), outstripping the increase in production, and thus caused the steady increase in the numbers of persons seeking work. Rationalization, changes in population structure and price-fixing the author dismisses in this connection. Finally, when the slump came, in 1929, wages continued to rise for eight months and in July, 1931, the index had fallen only 0.1 points, as compared with 30 points for wholesale prices, since September, 1929, and 19.6 points for the cost of living. Hence the catastrophic increase in unemployment. "What with wage and general social policy, one is forced to the conclusion that Germany has brought about her own downfall, and that too much emphasis has been laid upon Reparations, which, admittedly, are an additional evil" (p. 188).

One's attitude toward this argument will depend upon one's views as to wage

policy during depression. It is undeniable that wage rates are an important element in the variable costs of industry, and that reduction of wages may aid enterprises that otherwise would cease operation. But it is open to question whether, in the "short-run" of such a depression as overwhelmed Germany in 1930, under such conditions of fixed overhead charges, any practicable reductions in wages would have compensated for the rise in unit costs and prevented, or greatly lessened, the drop in employment. Wage cuts, of course, are inevitable in a depression of any length; the question is, whether the degree to which rates were maintained in 1930 was such as to merit the criticism levelled by Dr. Wiggs at the unions and the state. As to this, I, for one, am skeptical. On the other hand, that union policy in boosting wages was partly responsible for the increase in unemployment prior to 1930 cannot, I think, be denied.

William T. Ham

Harvard University

The Modern Corporation and Private Property, by Adolph A. Berle and Gardiner C. Means. New York: The Macmillan Company. 1933. 396 pp.

Many recent books purport to show the definite breakdown of economic processes and the need of revolutionary change. Less frequent but more significant is the type of work that traces the course of revolutionary change as it proceeds beneath our very noses. The present work, the joint effort of a lawyer and an economist under Social Science Research Council auspices, is of the latter sort. The idea is not new that the large corporation—quasi-public by virtue of the great number of its shareholders—is a party to important changes and problems. But the precise nature of the changes and the broad meaning of the problems have not heretofore been so effectively stated. Against the background of economic arrangements described by Adam Smith and his successors, the modern corporation—"a method of property tenure and a means of organizing economic life"—is seen as creating a new structure, "the corporate system," as compelling and distinctive as was the feudal system. The large corporation is thus revolutionary because it strikes the very heart of the older system through separating industrial control from ownership and the assumption of risk. With the interests of owning and managing groups diverging, more is at stake than the rights of scattered stockholders, though these are sufficiently important. The nature of property itself is changed, with the satisfactions and responsibilities entailed in its possession; and, more fundamentally, the social function of profits, in guiding and stimulating productive effort, is undermined. A limited number of individuals, in a capacity more managing than owning, are largely able to substitute their will and judgment for the broad, blind, automatic play of market forces. These conclusions the authors reach by methods whose variety adds interest to the work; statistical research, legal investigation, general economic reasoning, and free speculation all participating in the result.

The statistical study is concerned with the growing importance of large cor-

porations and the increasing diffusion of their ownership. Of 300,000 corporations in the country, the 200 largest non-financial corporations, with gross assets of upwards of $90,000,000, were found to own nearly half of all non-financial corporate wealth, about 33 per cent of all non-financial business wealth, and approximately 22 per cent of the country's total wealth. These 200 corporations, through reinvesting a larger fraction of their earnings, through security issues amounting (1922-27) to two-thirds of all public offerings, and through merger, have been growing more than twice as fast as other corporations. The seeming vitality of these enterprises suggests a continuation of the trend. Elaborate tabular displays reveal that most of these corporations are owned by many thousands of persons, with individual holdings, even of management, fractionally inconsequential. An interesting attempt to classify "control" in these 200 enterprises leads to the conclusion that, on the basis of the assets involved, only 6 per cent are controlled by majority stockholding, 14 per cent by substantial minority holdings, and 80 per cent either by management with little stock or by such a legal device as pyramiding or the use of non-voting stock. Thus "ownership of wealth without appreciable control and control of wealth without appreciable ownership appear to be the logical outcome of corporate development."

More than half the volume is devoted to analyzing, mainly along legal lines, the nature of property in corporate securities. With control largely divorced from ownership, the stockholder's position has been greatly weakened by recent corporation laws and the charters drawn under them. But for the amorphous principle that management stands in fiduciary relation to shareholders, the latter would seem, by act of purchase, to agree to thoroughgoing despoliation of themselves through the machinery of no-par stock, paid-in surplus, denial of preëmptive rights, stock-purchase warrants, blind and "parasitic" stock, combined with a broad latitude in rearranging participations through charter amendment. But so little disposed are the courts to censor the requirements of "business expediency" that the doctrine of "corporate powers in trust" is slight protection to security-owners, who must therefore rely upon the disposition of management to deal fairly and safeguard the future flow of capital into industry. The actual extent of victimization of shareholders is not appraised by the authors. With "active" wealth thus locked up in vast industrial units, the property of the ultimate owner depends considerably on the operation of security markets in assigning values and affording salability to the various equities. This aspect of corporate property rests largely on prevailing requirements surrounding the disclosure of significant facts by bankers and by the corporations themselves, and upon the market activity of "insiders." But in this connection a void seems to exist both in legal and economic theory.

Quite properly, and with fine effect, the authors have set forth what, to them, are the larger economic implications of their findings. It may appear, however, to some readers that the separation of ownership and control in large corporations has been awarded a somewhat more revolutionary significance than it deserves. The older social function of profits as reward both of

risk-bearing and of management may not apply, it is true, when these duties are divided; and certainly no social gain derives from granting ownership a larger reward than the waiting and risk-taking functions require. But the ordinary measure of net earnings for a corporation, as compared with a single enterprise, already largely reflects this division of entrepreneurship; and if, for the sake of an adequate incentive, it seems desirable to compensate management liberally with commissions or bonuses dependent upon earnings, the step is not especially revolutionary, however subject to abuses at the outset. That "extra profits" go to ownership beyond the socially justifiable amount and should be rerouted to "control" requires definite demonstration. "Pure" profits may already be negative, on the broad average; and, in any event, the existence of a *prospect* of profit more than sufficient to induce the assumption of business risk is not to be taken for granted. Such influence on net earnings as may be exerted by contractual interest rates and by monopoly lies, of course, outside the area of discussion, since they involve issues quite different from the separation of risk and control in corporations.

But if, as may plausibly be contended, the theory of the profit system in any guise must fail to work; if now more is to be learned of economic motivation from an Alexander the Great than from Adam Smith's petty tradesman; if a wholly new concept of business enterprise has become necessary; even so, the corporate form of organization with its separation of ownership and control may easily be accorded too prominent a place in the explanation. After all, if huge business units have the assured future in which the authors believe, it is because the technological conditions of production require them. Here, then, the revolution lies. The corporation form of organization is merely a means, however indispensable, to their establishment. If it should appear that "bigness" is largely due, not to the conditions of progress in supplying goods, but to opportunities, afforded by the corporate form itself, for profits and power from monopolistic combination and from the very promotion and underwriting and controlling of great enterprises, then, perhaps, the apparent trend toward bigger units would not be looked on as inevitable, except by supporters of *laissez-faire*—which the authors plainly are not. If a system of free enterprise, with its machinery of profits and competition, is still compatible with the scale of enterprise and diffusion of ownership economically necessary, then conceivably the framework of organization can be adjusted to this situation. If not compatible, but private ownership of industry is to continue, then we may look for amendment of the corporate device along lines in keeping with some such new conception of business enterprise as the authors suggest may come to prevail.

Shorey Peterson

University of Michigan

Studies in English Trade in the Fifteenth Century. Edited by Eileen Power and M. M. Postan. (London School of Economics' Studies in Economic and Social History, V.) London: George Routledge and Sons. 1933. xx, 435 pp.

This group of essays on the history of English trade is the work of the seminar in economic history at the London School of Economics, supplemented by material and an essay contributed by Professor H. L. Gray. Although the studies do not present a comprehensive account of the movement and organization of fifteenth century trade they contribute a large amount of new material to a neglected period. As the primary materials in the Customs Accounts have been tabulated for the entire period 1399-1482 and are printed in full in the appendices, the volume has a very broad significance. No previous study has furnished so large a mass of material for the statistical study of English trade in the middle ages.

The material presents various difficulties. Exports of wool and cloth and imports of wine are reported in units of quantity. The trade in other commodities is reported without discrimination in the statements of the petty customs and the poundage duties. Unfortunately, exports and imports are not distinguished. Nevertheless, by careful utilization of contemporary materials Professor Gray has been able to present an approximate table of the average value of exports and imports for the periods 1446-48 and 1479-82.

AVERAGE ANNUAL VALUE OF EXPORTS AND IMPORTS

ENGLAND, 1446-48

Exports

	Wool	Cloth	Miscellaneous	Total
	(Thousands of pounds sterling)			
Staplers	44.8	....	....	44.8
Merchant adventurers	...	60.1	4.0	64.1
Total denizens	44.8	60.1	4.0	108.9
Hansards	....	23.3	2.0	25.3
Other aliens	11.2	32.0	5.0	48.2
Total aliens	11.2	55.3	7.0	73.5
Total	56.0	115.4	11.0	182.4

Imports

	Wine	Wax	Miscellaneous	Total
	(Thousands of pounds sterling)			
Staplers	....	....	....	....
Merchant adventurers	32.7	0.0	53.1	85.8
Hansards	....	1.0	10.8	20.8
Other aliens	12.4	....	27.7	40.1
Total aliens	12.4	1.0	47.5	60.0
Total	45.1	1.0	100.6	140.7

Owing to the vicissitudes of foreign and civil wars, the trade of the latter period is only slightly greater than the trade of the earlier period, so that the interest of the study lies in the commodities and in the proportions of the trade in the hands of natives and aliens rather than in growth. The general results of the study are thus summarized in the statements of exports and imports.

The other essays in the volume constitute an extended commentary on the primary elements of these tables. The operations of the Staplers is the subject of the essay on the wool trade and an essay on the relations of the Staplers with the Lancastrian government. The relations of the Merchant Adventurers to the Great Livery Companies, which have been very incompletely understood in the past, are studied in the light of extensive masses of new material in the essay on the Grocer's Company. There is also an essay on the Hansards based on recent German literature and the large masses of documentary material now available in print. Studies of the Iceland trade and the foreign trade of Bristol furnish important evidence on special topics. The volume thus affords a basis for a thorough understanding of the organization and movement of England's trade in the fifteenth century.

Abbott Payson Usher

Harvard University

Social Statistics, by R. Clyde White. Harper's Social Science Series, edited by F. Stuart Chapin. New York and London: Harper and Brothers. 1933. x, 471 pp.

This is the first text-book in the United States that deals adequately with elementary statistics as applied to sociology and social work. Mr. White has been successful in fulfilling his aim which was to "adapt statistical methods to the data of sociology and social work for teaching purposes. . . ."

The book is presented in two parts. Part I, Introduction, contains more than is ordinarily found in an introduction. The first chapter gives the usual preliminary material, and the second a discussion of the "Sources of Published Statistics." This is not merely a listing but is also a discussion of the various kinds of agencies engaged in collecting statistics. This type of discussion is very helpful in view of the rapid change in the field of social data. Chapter three, "The Nature of Statistical Research," reconciles case work and statistical research. Case work has long been the fort and often the sole tool of social workers so that now there is great need for training in statistical techniques. The case method and statistical method should be complementary. In chapter four, the last in Part I, the author has described the working out of two statistical problems: one done by himself using primary data on cases disposed of by the Marion County Criminal Court of Indianapolis, Indiana, and the other, a problem using secondary sources, "Social Aspects of the Business Cycle," by Dorothy S. Thomas.

Part II, Statistical Analysis, with two exceptions, presents chapters on the ordinary range of subjects in the following order: collection, tabulation, graphic

presentation, measures of central tendency, measures of dispersion, index numbers, measures of relationship, the theory of probability, and time series. There are at the end two chapters which are not usually found: one on vital statistics and one on rating scales.

The discussion of tabulation is excellently done for teaching purposes, although as is often the case, the illustrations being set in type do not rigidly follow the rules discussed. "Graphic Presentation" is introduced with a discussion of rectangular coördinates and is followed by a treatment and illustration of line graphs of various kinds, frequency histograms, polygons and curves, bar graphs, circle and sector diagrams, maps, and an organization chart. Scattergrams, not discussed as a graphic device, are included as a supplement to correlation analysis later.

The chapter on averages treats the mode, median, arithmetic mean and geometric mean. Here is a very clear discussion of the reason for using a mid-point of a class-interval in the computation of the arithmetic mean from a frequency distribution, but no explanation is given for the use of that same mid-point in computing the geometric mean, although the author of the book clearly recognizes that the geometric mean is smaller than the arithmetic mean. The chapter on index numbers gives a good discussion with illustrations of actual computations. The author has not been consistent with his use of symbols however. At first he uses w to indicate weights and then changes to q when discussing Fisher's Ideal Formula. His use of subscripts in this chapter is not uniform.

Mr. White has been very careful to give a clear statement of the problem of correlation. He has tried but has not been very successful in getting away from the old "cause and effect" description of the subject. "Instead of speaking of one fact as a cause and another as an effect of the first, it is the habit to speak of one fact as the *independent variable* and of the second as the *dependent variable*. In some cases the dependent variable might just as well be treated as the independent variable" (p. 178). But, he has earlier defined variables: "Variables may be classified as independent and dependent. This means that one series of facts to which another series is related is treated as cause, and that the second series changes in accordance with the first." (p. 68).

Correlation is introduced by presenting the meaning of a functional relationship and the standard error of estimate from a curve. White doesn't get to the algebraic definition of a coefficient of correlation until his 20th page. This is the first elementary text in statistics which defines and makes use of the corrected r and S_{xy}. No mention is made of part, partial or multiple correlation. The method of rank correlation which may be of considerable advantage, particularly in some fields of social statistics, is likewise not treated.

The theory of probability has been presented in a manner similar to that of Mills' *Statistical Methods*. In the computation forms for the fitting of lines in the chapter on relationships and in that on trends, the symbol U has been introduced for X^2. This added symbol serves only to confuse. The chapter on time series comes farthest from meeting White's ideal of teachability. The chapter does not come up to the standard set in the rest of the book for

clear statement and complete description. At many points it is difficult to understand and is very confusing.

The chapter on vital statistics serves the purpose of a chapter on rates as well as to present in simple manner the problems related to population, viz., growth, marriage and divorce, birth rates, death rates and morbidity. The second exceptional chapter discusses the problem of rating scales which has come to be of considerable importance in recent years. Examples of different kinds of scales are given.

The book is well printed and securely bound. Relatively few errors in printing have crept in, although there are a few, such as the turning of the graph on page 155. This book can be used without a laboratory manual if desired since exercises appear at the end of each chapter. References to collateral reading follow each subject treated.

Lester S. Kellogg

University of Buffalo

Contributions to the History of Statistics, by Harold Westergaard. London: P. S. King & Son. 1932. viii, 280 pp.

Statistics is probably older than economics. Even if the earlier German university statistics be left out of account, the origin of the study can be traced back to A.D. 1662 when Graunt's *Natural and Political Observations* was published, and at that date modern economics had produced no book that proved equally seminal. Statistical societies, which have done much to foster an interest in the history of their field, have been active perhaps twice as long as economic societies.

Notwithstanding the fact that economics is the younger study its history has been treated much more fully than that of statistics and accordingly the present "Contributions" from one who has greatly enriched the latter subject is to be cordially welcomed as helping to fill a lacuna in our knowledge. The author believes that the three main roots of statistics are Staatenkunde, or the comparative description of states, political arithmetic, and the calculus of probabilities, the first originating in Germany, the second in England, the third in Italy and France. He aims to show how they have blended into the statistics of today. The book is composite not only because the author so conceives the subject, but because its development in different countries has varied both in direction and in speed. A real history of statistics as an international discipline must probably wait until more spade work has been done in the history of statistics in the several countries. In the present work the geographical classification sometimes interferes with the logical, although in the later period when statistics became more international this difficulty dwindles.

Professor Westergaard's conception of statistics is one he elaborated more than half a century ago in his first book. During that interval it has not won general acceptance or even gained much ground. What recent writer begins, as our author began the 1882 edition of his *Mortality and Morbidity*, with an

explanation of the law (so-called) of large numbers and the concept of probability? Mathematical principles, to be sure, can be used to test many statistical results, but are they the only test? Does not the congruity of the conclusions reached in statistics, as in the physical sciences, constitute an important test of correctness? Perhaps Professor Westergaard's approach to statistics through actuarial studies (he dedicated his first book to an English actuary) has led him to emphasize more than others the mathematical phases of his subject.

Even if one agrees with him that statistics is a blend, the question still arises whether its components have been rightly conceived. Perhaps it is, as Knies said long ago, both a method and a science. If so, the history of either might be coherent, but a consecutive history of the two is hardly possible. If statistics be a method, then its achievements in the physical sciences, hardly mentioned by Westergaard, deserve recognition. If it be a science, demography, based on complete enumeration, then his chapter on Staatenkunde might be omitted and his emphasis on the calculus of probabilities diminished. With complete enumeration it seems unnecessary to invoke the calculus to adjudicate upon the trustworthiness of the results for the population enumerated and at the time of enumeration, and the question whether those results will apply to the same group at another time turns upon the rate of group change where, again, abstract mathematics is of little help. The calculus becomes important when the question is whether what is true of a sample is true of the whole. But even there, while it throws light on the question whether the sample is large enough, it throws little on the question whether it is representative.

We echo the author's hope that the book will prove to be the forerunner of a projected forecast for the future of statistics, a study to which his life has been devoted and in which he has garnered an abundant harvest. Few indeed are better equipped to anticipate the trend of statistics in the next generation.

WALTER F. WILLCOX

Foreign Investments in China, by C. F. Remer. New York: The Macmillan Company. 1933. 708 pp.

Professor Remer has undertaken in his *Foreign Investments in China* a very difficult task and has performed it well. He has made an important contribution to the understanding of economic conditions in the Far East. The field is one in which the data are incomplete and inaccurate as well as complicated, but the importance of bringing together, for the first time, material on foreign investments in China as a whole is sufficient justification for the use of such data. The study has been carried on over a number of years and is based not only upon the research and investigations of the author in China, Japan, Russia, Germany, France, England and the United States, but also upon independent investigations of the Institute of Pacific Relations in Japan, the Royal Institute of International Affairs in Great Britain, and of well-known economists in Russia and China. One of the difficult tasks of the study has been the merging of these separate investigations into a comparable whole;

and one of Professor Remer's contributions has been to point out the weaknesses and the gaps in the material.

The book is divided into two parts. In the second part the author has presented the results of the separate investigations, by countries, not as they were turned over to him, but rearranged and made comparable and with additions from his own store of information. Part I presents the final results of the whole study and the author's analyses. It gives the complete story so that it is not necessary for the reader to go into the details of Part II unless he is especially interested in the field or in the methods used in making the estimates. There is, however, a great deal of interesting material to be found in Part II.

The first four chapters of the book supply a background of conditions in China necessary to the understanding of the problem under investigation. The remainder of Part I is given over to the analysis of foreign investments in China and their place in China's balance of payments. The analysis shows the continued preponderance of British interests in foreign investments in China and the important increase, since the World War, of the investment interests of Japan—a normally capital importing nation. It shows the concentration of foreign interests in Shanghai with the British in the lead and the Japanese gaining in importance, and the growing significance of Japanese interests in Manchuria. It points out that transportation has been the dominant field of foreign investment with trade coming next and manufacturing and real estate in third and fourth place.

It further discloses that the preponderantly important share of foreign investments in China is and always has been in the form of direct business investments, rather than in loans to the Chinese government or investment in Chinese institutions, and that direct investments by foreign nations and by private interests have, at times, been the instrument of political intrigue for the acquisition of Chinese territory or other political gain. That there has been almost no investment through Chinese corporations is pointed out and explained, in part, by the lack of Chinese experience in the operation of industrial plants, by the fact that the Chinese corporation seldom borrows as long as the corporation is financially successful, and in the difficulty of handling matters that go before a Chinese court. Foreign indebtedness by the Chinese government began with loans to meet the indemnity imposed by Japan after the Sino-Japanese War and although in the intervening years there has been some borrowing abroad for economic purposes, mainly for railway construction, it has not been great and the bulk of the foreign obligations contracted by China has been as a result of war, anti-foreign disturbances, civil strife and political intrigue. As Professor Remer says, the Chinese government has been an indemnity paying institution rather than a capital importing institution, and he believes that a fundamental problem in China today is the creation of a Chinese government which will provide the leadership for the economic development of the country.

The place of foreign investments in the international balance of payments has been assessed and the author has made a new estimate of the Chinese balance of payments disclosing a large unexplained difference between outpay-

ments and inpayments not accounted for by foreign investments, remittances from overseas, or expenditures of foreigners in China.

The author believes that there is need of further investment of foreign capital in order for China to find a way to live in the modern world but he thinks that China must have that foreign capital without political domination or economic exploitation. He urges the importance to the world of raising the low standard of living of the Chinese millions and the necessity of directing the use of foreign capital to that end.

It is possible to criticize some of the estimates and some of the methods used, but the author is scrupulously honest in his statistical presentation and is fully conscious of the weakness of his data. In spite of the technical aspects of the study and the generous use of tables, charts and statistical material, *Foreign Investments in China* is very readable. It is simply and clearly written and carefully summarized at the end of each chapter. Professor Remer has not been overwhelmed by the mass of statistical material. He brings to his statistical analysis a genuine appreciation of China's political and economic problems.

Columbia University JOHN E. ORCHARD

Growth of Trade and Industry in Modern India, An Introductory Survey, by C. N. Vakil, S. C. Bose and P. V. Deolalkar. London: Longmans, Green and Company, Ltd. 1931. 398 pp.

Growth of Trade and Industry in Modern India is a sincere attempt to analyze the problems of India's industrial and commercial growth under British rule. It presents the Indian viewpoint and as such has a distinct value. The authors believe that though India's immediate problem seems to be political, the real problem is economic, and they ask the question how beneficial to the Indian people have been the foreign trade and modern industry developed under British domination. They look at the preponderance of raw materials in export and of manufactured goods in import and question the wisdom, for India, of the British policy that has insisted until recently upon free trade and has stimulated industrial agriculture but retarded the development of modern manufacturing. The steadily rising excess of exports over imports is not evidence of prosperity to the Indian, but of a drain upon the raw materials which the Indian people themselves might use to build a new industrial economy; the foreign capital and foreign management in trade and industry mean lost opportunity, the outflow of profits to non-Indians, and the loss of valuable experience, enterprise and knowledge of technique which given to Indians would help them to rebuild their economic structure along modern lines. The book is divided into four parts. The first part concerns the trade in food grains, the development of the tea and coffee trade, the sugar industry and salt. The second part deals with the various textiles; the third part with minerals; and the fourth with a miscellany of industries. Some very useful and interesting historical data have been assembled and the possibilities and obstacles to future development in each field are discussed in the light of the welfare of the Indian people.

Columbia University JOHN E. ORCHARD

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